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THE CHRISTIANSEN EXPERIMENT*

THE present article is concerned with the phenomena observed in the well-known optical experiment embodying the principle of the so-called Christiansen filters used for isolating monochromatic radiation from white light. A transparent isotropic solid is powdered and placed inside a flat-sided cell of glass, and the latter is then filled up with a liquid of which the refractive index is adjusted to equality with that of the powder for any desired wavelength in the spectrum. The cell then becomes optically transparent for such wavelength, which the rest of the spectrum is not transmitted but only diffused in its passage through the cell.

The material usually recommended for use in Christiansen filters is powdered glass which needs to be specially prepared. We have found that a convenient substance to employ in experimental studies of the Christiansen effect is hexamethylenetetramine, also known as hexamine or urotropin, which is both inexpensive and readily available as a crystalline powder. Hexamine is optically isotropic and its refractive index is intermediate between those of benzene and carbon disulphide in either of which it is nearly insoluble. Beautiful chromatic effects are observed when hexamine powder is placed in a cell and filled up with a mixture of benzene and carbon disulphide in the proportion of roughly one to four. For visual observations, it is convenient to employ, instead of a flat-sided cell, a stoppered hollow prism of 60° angle to contain the material. The advantage of doing this is that the prism functions both as a containing cell and as a dispersing apparatus. All that is necessary is to view the incandescent filament of an electric lamp from a distance through the prism held close to the eye. The spectral character of the transmitted light then becomes immediately evident, and by moving the eye to different positions on the prism face, the various effects described and illustrated below may be observed.

* Sir C. V. Raman, "The Theory of the Christiansen Experiment," *Proc. Ind. Acad. Sci.*, 1949, **29A**, 381-90. See also, 1949, **30**, 211-15 and 277-83.

The spectral character and intensity of the transmitted light in the Christiansen experiment is influenced by several factors, of which the depth of the column through which the light filters is of particular importance. The set of six spectrograms reproduced in Fig. 1 exhibits

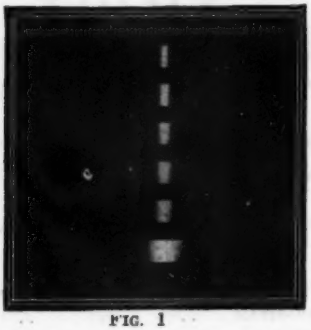


FIG. 1

the sharpening of the spectral band of transmission with increasing thickness of the filter; the uppermost corresponds to a thickness of 18 millimetres and the lowest to 1·5 millimetres. The exposure given had to be greatly increased with increasing thickness of the material so as to record the transmitted light with approximately the same intensity.

The size of the particles of the powder is also of great importance in determining the spectral character of the transmitted light. This effect is illustrated in the series of four spectrograms reproduced in Fig. 2. These were obtained with

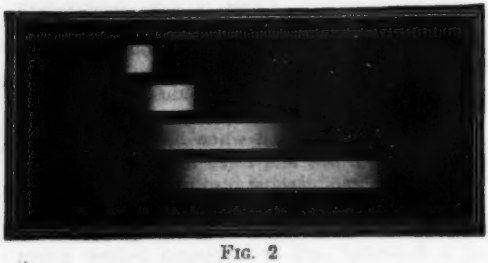


FIG. 2

powdered glass the particles of which had been graded by sieving and elutriation into four groups having respectively as average diameters 300 μ, 100 μ, 18 μ and 9 μ, the thickness of the layer traversed being the same, *viz.*, 3 mm. The composition of the benzene-carbon disulphide mixture covering the powder was also adjusted to be as nearly as possible the same in the four cases. From the figure it will be seen that spectral width of the transmitted light becomes very great when the particle size is small. The widening is also totally unsymmetrical; the spectrum stretches further and further towards the red, while its short wavelength limit remains unaltered.

The series of spectrograms reproduced as Fig. 3 exhibits another effect of interest. They

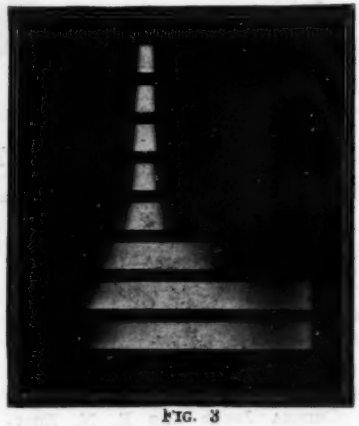


FIG. 3

were obtained by focussing the light of a carbon arc on the slit of a spectrograph after passage through a cell containing hexamine powder suspended in a considerable excess of a benzene-carbon disulphide mixture. In the first of the series, the powder was distributed more or less uniformly throughout the entire volume of liquid. The subsequent spectrograms were recorded at short intervals of time following each other as the powder settled down in the cell, finally leaving the region traversed by the light beam nearly free of suspended powder except for the finest particles of all. The progressive increase in the spectral width of the transmitted light is particularly conspicuous in the last few spectrograms. The unsymmetrical character of this broadening is also strikingly evident. The effects noticed are a consequence of the diminishing quantity of suspended solid which is effective as well of the increasing fineness of its particles. The former of the two effects can be demonstrated separately by comparing the character of the transmitted light when the powder has all settled down to the bottom of the cell with that observed when the powder is distributed uniformly throughout the volume of the liquid.

The difference in the dispersive powers of the solid and the liquid also plays a decisive role in the Christiansen experiment. This be-

comes particularly obvious when this difference is very small. The series of spectrograms reproduced in Fig. 4 shows the spectral character of the light transmitted through different thickness of potassium chloride powder immersed in tetrachloroethane (symmetric), to which a few drops of carbon tetrachloride had been added. Practically the whole of the spectrum appears in the transmitted light when the thickness of the layer is a millimetre or two. A thickness of nearly a centimetre is necessary before any concentration of intensity in the region of equality of refractive indices of the solid and the liquid becomes noticeable. Even so, the transmission extends to the extreme limit of sensitiveness of the photographic plate in the red, while on the other hand, there is a complete cut-off on the violet side. Very different results are obtained when, instead of tetrachloroethane, either toluene or an acetone-carbon disulphide mixture is employed. These liquids have a much higher dispersive power than potassium chloride.

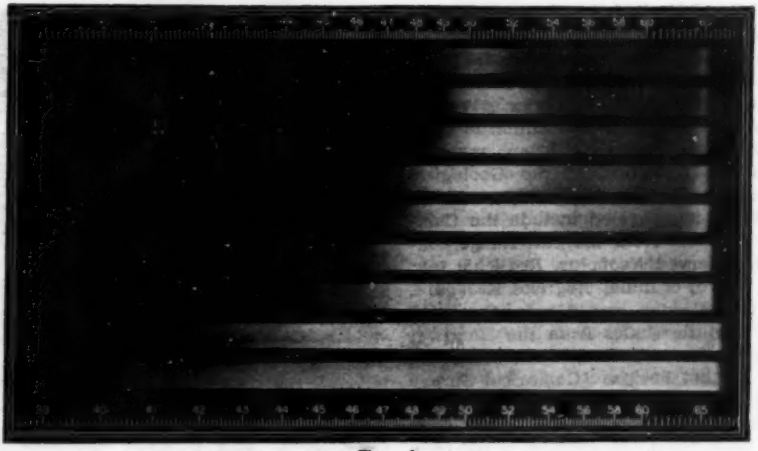


FIG. 4

On a superficial view, one may be tempted to believe that the optical behaviour of a Christiansen filter is a matter of geometrical optics, the part of the spectrum at which there is equality of refractive index coming through without deviation, while the rest of the light is diffused as a result of multiple reflections and refractions. Such an explanation of the action of the filter is, however, not only inadequate but definitely misleading as can be seen from the facts set out and illustrated in this article. In a paper published recently and referred to above, an attempt has been made to deal with the subject from the standpoint of wave-optics. The expressions developed in that paper for the extinction coefficient of a Christiansen filter afford at least a general explanation of the facts of observation set forth in the present article. It appears not unlikely however that a fresh approach from the standpoint of the electromagnetic theory of light may be necessary to give a more complete account of the observed phenomena.

C. V. RAMAN.
M. R. BHAT.

ASTRONOMICAL AWARD TO PROF. S. CHANDRASEKHAR

THE Gold Medal of Britain's Royal Astronomical Society—the Society's premier award—has this year been awarded to Professor S. Chandrasekhar for his contributions to mathematical astrophysics. The Medal, which is awarded annually for eminent contributions to the study of astronomy, was first awarded in 1824.

Professor Chandrasekhar is a Distinguished Service Professor of Theoretical Astrophysics at the Yerkes Observatory, Wisconsin, U.S.A. He has written a number of important books on astronomy, among them: "An Introduction to the Study of Stellar Structure" (1939), "Principles of Stellar Dynamics" (1942) and "Radiative Transfer", (1950).

EVIDENCE FOR THE EXISTENCE OF VASCULAR LAND PLANTS IN THE CAMBRIAN

K. JACOB, MRS. CHINNA JACOB AND R. N. SHRIVASTAVA
Geological Survey of India

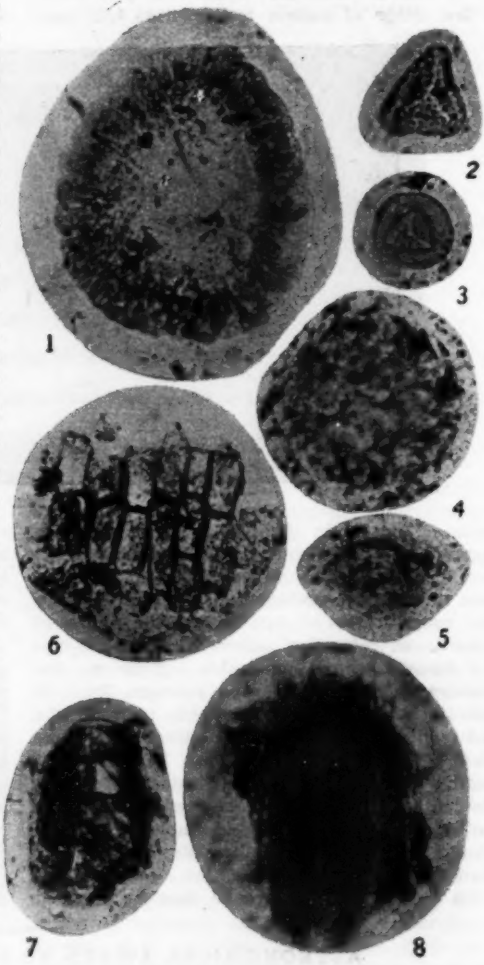
A. K. GHOSH AND A. BOSE in a series of short papers have recorded the presence of spores and woody elements in the Cambrian of the Salt Range[1,2,3] and Kashmir,[4] and from the Vindhyans.[5] With a view to verifying some of their findings which had raised some doubts in India, A. K. Ghosh handed over some of his material to us for investigation in the laboratories of the Geological Survey of India. In addition to these samples, some authentic Cambrian material available in the collection of the Geological Survey were also examined by us.

The specimens investigated include the Cambrian Neobolus shale from the Salt Range containing well-preserved *Neobolus, Redlichia,* etc. (Geological Survey of India, Reg. Nos. K33/591 f, K 17/480), the Middle and Upper Cambrian olive-green, phyllitic shales from the Hundwar Tehsil of Kashmir with *Tonkinella,* ? *Obolus,* etc., present in that horizon (Geological Survey of India, Reg. No. K32/248) and the Upper Cambrian dark grey, fine-grained shale from the Parahio river, Spiti. In addition, a specimen of ? "Neobolus shale" from the Salt Range collected by the geologists of the Burmah Oil Co., and kindly handed over to us by A. K. Ghosh was also examined. Ghosh and Bose[2] have described the organic remains recovered by them from this material.

Samples were treated in hydrofluoric acid and macerated in Schultze's fluid. All possible precautions were taken to avoid contamination in the laboratory.

All the above-mentioned samples examined by us yielded well-preserved spores, tracheids and what appear to be bits of cuticles. On the whole, we support Ghosh's general findings from the Cambrians of India that traces of vascular plants occur in these ancient sediments, but we differ from him in certain details. At least 43 different types of spores were obtained from the different samples examined by us. Some of the organic remains are identical with those found by him.

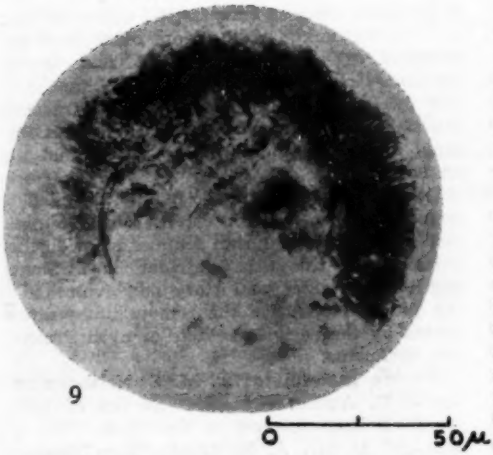
All the spores are cutinised and are light yellow in colour. The shape in the majority is generally round or oval with or without triradiate mark. Spores which are triangular in outline with a clear triradiate mark and well-developed sculpture are found only in the ? "Neobolus shale" of the Salt Range collected by the Burmah Oil Co. These



FIGS. 1–3.—Spores from the Neobolus shale, Salt Range (B.O.C. Coll.).

FIGS. 4, 5.—Spores from the Neobolus shale (Cambrian), Salt Range (G.S.I. Coll., K 17/480).

FIGS. 6, 7—Cuticle (6) and spore (7) from the Neobolus shale (Cambrian), Salt Range (G.S.I. Coll., K33/591f).



FIGS. 8, 9.—Woody elements (8) and pollen (9) from the olive-green shale (Cambrian), Hundwar tehsil, Kashmir (G.S.I. Coll., K32/248).

appear to belong to the primitive pteridophytes. Some of them may even be pteridospermous. Only two are figured here (Figs. 2 & 3).

There are much larger spores, round or oval in outline, possessing a central body, more than 50 μ in diameter in some cases, and a prominently frilled margin (Figs. 1 & 9). In one or two a triradiate mark is visible. Spores of this general type measure 75 μ-130 μ in diameter and are fairly common in the Middle and Upper Cambrian of Kashmir (Fig. 9) and the ? "Neobolus shale" of the Salt Range collected by the Burmah Oil Co. (Fig. 1). At least three distinct types of this group are present in the Kashmir Cambrian sample examined. It is possible that they belong to the Pteridospermæ.

Pollen with two distinct bladders are found in the ? "Neobolus shale" from the Salt Range (B.O.C. Coll.), the Upper Cambrian of Spiti and the Middle and Upper Cambrian of Kashmir. While at least three distinct and well-developed types of this group are recovered from the "Neobolus shale" (B.O.C. Coll.) only two types quite distinct from each other and quite different from any found in the ? "Neobolus shale" (B.O.C. Coll.) occur in the other two localities. Those from the Burmah Oil Co., ? "Neobolus shale" resemble some of the late Palæozoic ? gymnospermous or pteridospermous pollen.

Round or oval spores with faint partition lines simulating a coarse network are found to occur in the Cambrian of Kashmir (37 μ diameter) and the Cambrian Neobolus shale (G.S.I. Coll.) of the Salt Range (50 μ diameter).

A piece of undoubted plant matter recalls what Reissinger[9] distantly compares with Equisetalean prothallia from his material of the Lower Cambrian blue clays of Esthonia. Such comparisons with delicate plant matter which have hardly been met with in the fossil state, should be taken with reserve in the absence of convincing evidence.

It is difficult to suggest the affinities of the woody elements (Fig. 8), several fragments of which have been obtained. While most of them are dark yellow in colour with well-developed bordered or simple pits, some appear to be carbonised. The fragments with bordered pits and the simple pitted carbonised bits from the Spiti and Kashmir Cambrians, are indistinguishable from those shown in Pl. IV, Figs. 7, 12 & 13 of the woody elements from the blue clays of the Cambrian of Kunda in Esthonia.[9] The cuticles are devoid of any stomata in the very fragmentary pieces recovered (Fig. 6).

At least 6 different types of spores from the Cambrian of Spiti, 6 from the Cambrian of Kashmir and 31 from the ? "Neobolus shale" of the Salt Range (twelve in the G.S.I. material and nineteen in the B.O.C. specimen), were obtained in the slides so far examined. The descriptive account of the individual spores will appear in the detailed paper to be published elsewhere. We are inclined to believe that the primitive pteridophytes and the pteridosperms are represented in the Middle and Upper Cambrian sediments examined by us.

The authors would particularly draw the attention of geologists and palæobotanists to the important contributions by Naumova,[6] Kopeliovitch,[7] Reissinger[8,9] and Darrah[10] describing spores of vascular land plants from the Cambrian sediments of Europe.

The general conclusions drawn by Naumova[6] regarding Cambrian spores are not quite in agreement with our observations regarding the size, shape and sculpture of the spores from the Indian Cambrians. The Indian triletes so far recovered by us vary in size from 5 μ-50 μ and the larger frilled spores from 75 μ-130 μ. According to Naumova the Lower Cambrian Pre-Baltic spores from Russia are comparatively small in size varying from 15 μ-25 μ, exclusively round or oval in outline with simple sculpture and well-developed folds indicating a comparatively thin spore coat. Those described by Reissinger[9] also generally agree in shape, size and sculpture with the Pre-Baltic spores. The spores from the oil shales of the Kolm in Sweden described by Darrah[10] are somewhat larger in size and are probably all referable to the Bryophyta or

the Pteridophyta. Apparently, the Indian Cambrians show more highly evolved spores of comparatively large size some of them possibly belonging to the Pteridospermæ. Spores of triangular outline are particularly common in the sample of ? "Neobolus shale" from the Salt Range collected by the Burmah Oil Co.

The spores from this sample are so well-preserved and so abundant in the slides with several distinct types showing well-developed sculpturing and with quite a few triangular spores that we are somewhat doubtful as to its correct horizon. Further, the spore assemblage even including two-bladder ? pollen closely resembling *Pityosporites* with well-developed striations on the body of the spore, also recalls to a great extent those recovered from the Lower Gondwana sediments of the Salt Range (Speckled sandstone—Middle Products beds) and Pali, Rewah.[11] The B.O.C. specimen is a fine-grained greenish sandstone with streaks of carbonaceous matter with no Cambrian animal remains preserved to be quite certain of its provenance. For the time being we, therefore, hold this specimen as of doubtful Cambrian age, the spores contained in them showing a late Palæozoic affinity, unless, of course, it turns out that the Cambrian forms were already well developed and persisted right up to the Permian without much modification! This was rather unlikely.

The other Cambrian shales from which spores and tracheids have been recovered by us, are, we are convinced, of Cambrian age. On the whole, we believe that there is sufficient evidence to indicate as Naumova,[6] Reissinger,[8,9] Darrah,[10] Ghosh[4] and Jacob[12] have already pointed out, that the vascular land plants were in existence even as early as the Cambrian and not entirely unknown in strata older than the Silurian, as generally believed. The spores, tracheids and cuticle, bear out the fact that the vegetable kingdom had already reached this stage of development during the early Cambrian at least, paving the way for animal life on land.

The present short note is mainly intended to emphasise the need for a careful and systematic search of the pre-Silurian sediments for further evidence of traces of vascular land plants, and to determine the history and evolution of the plant kingdom in the remote times represented by the early Palæozoic or even Proterozoic sediments.

We are grateful to Dr. M. S. Krishnan and Dr. J. B. Auden, Geological Survey of India, for their keen interest in the work. We are thankful to Mr. A. K. Ghosh, Bose Research Institute, Calcutta, for kindly giving us a copy of the English translation of Naumova's paper in Russian and to Mr. P. K. Nag for help in taking some of the photographs.

1. Ghosh, A. K. and Bose, A., *Nature*, 1947, **160**, 796. 2. —, *Trans. Bose Res. Inst.*, 1950, **18**, 71. 3. Ghosh, A. K., Sen, J. and Bose, A., *Geol. Mag.*, 1950, **88**, 129. 4. Ghosh, A. K. and Bose, A., *Nature*, 1952, **169**, 1056. 5. —, *Sci. and Cul.*, 1950, **15**, 330. 6. Naumova, S. N., *Rep. Acad. Sci. U.S.S.R., Geol. Ser.*, No. 4, 1949. 7. Kopeliovitch, A. V., *C.R. Acad. Sci. U.S.S.R.*, 1951, **78**, 975-77. 8. Reissinger, A., *Palæontogr.*, 1939, **84**. 9. —, *Naturwiss. Gesselsch. Beyreuth*, 1952, 1-24. 10. Darrah, W. C., *Science*, 1937, **86**, 154-55. 11. Virkki, C. (Mrs. Jacob, C.), *Proc. Nat. Acad. Sci. Ind.*, 1945, **15**, 93-176. 12. Jacob, K., *In Gen. Rep. Geol. Surv. Ind.*, 1950, *Rec. Geol. Surv. Ind.*, **84** (in the press).

INDIAN RARE EARTHS FACTORY

THE Indian Rare Earths Ltd., Alwaye, which was formally opened by the Prime Minister, Shri Jawaharlal Nehru, on 24th December, came into being in September 1950, after the deliberations of a Committee set up by the Government of India in July 1949. The Board of Directors consists of: Mr. J. D. Choksi, Dr. H. J. Bhabha, Dr. S. S. Bhatnagar, Mr. K. R. K. Menon, Dr. K. S. Krishnan, and the Chief Secretary and the Finance Secretary of the Government of Travancore-Cochin.

The occurrence of monazite in Travancore-Cochin State was first discovered by the German chemist, C. W. Schomberg, in 1909. This discovery was followed almost immediately by an investigation of the area by the Geological Survey of India. Monazite was first exported to U.K. in the year 1910. When the agreement between the Government of Travancore and the British firm lapsed, further exports were banned by the Travancore Government.

The factory can process 1,500 tons of monazite sands a year. The sand will be supplied by the Government of Travancore-Cochin. The main products are rare earth chlorides and rare earth carbonates. The plant is capable of producing the entire earth as either chlorides or as carbonate. This is due to the fluctuating nature of the demand for these products. It can produce a maximum of 1,650 tons of chlorides or 1,150 tons of carbonates. Normally it will produce approximately 1,000 tons of chlorides and 450 tons of carbonates. The by-products are between 1,500 to 1,800 tons of crystalline tri-sodium phosphate and 9,000,000 gallons of caustic soda lye in 10 to 12 per cent.

solution. The residue, after all this extraction, when suitably treated, can yield approximately 205 to 228 tons of thorium nitrate, provided all the thorium is converted to nitrate. These figures are variable as the thorium oxide content of monazite is known to vary from 8 to 9·5 per cent. This residue will be treated by a factory being set up by the Atomic Energy Commission for the production of uranium and thorium compounds. This factory will also extract uranium.

PROFESSOR B. B. MUNDKUR—OBITUARY

THE passing away of Professor Balachandra Bhavanishankar Mundkur, Professor of Botany, Poona University, and noted Indian Mycologist on December 13, 1952, will be received with deep regret both in this country and abroad. Prof. Mundkur was born on January 26, 1896 in the village of Mundkur near Mangalore on the West Coast of India in the State of Madras. He was the only son of his father. He matriculated in 1915 and had his early collegiate education at the St. Aloysius College, Mangalore. In 1920 he took his B.A. (Hons.) Degree in Botany and passed out First Class with a Gold Medal from the Presidency College, Madras. For a short period after graduation, he was Agricultural Officer in Bengal and from 1922 to 1928 was Assistant Mycologist in the Cotton Research Scheme at Dharwar from where the bulk of his pioneering published work on the cotton wilt problem appeared. He obtained his Doctor of Philosophy degree from the Iowa State College, Ames, Iowa, in Plant Pathology, working there between 1929-31. On his return to India, Dr. Mundkur was appointed as Assistant Mycologist in the Mycology Division, Indian Agricultural Research Institute, Pusa, Bihar. Indeed, his association with this Institution both at Bihar and New Delhi until 1947 for well over sixteen years marked a period of great mycological activity, and he not only published several scientific papers and monographs on Indian *Synchytrium*, Indian *Phyllosticta*, *Pestallotia* and *Monochætia* and Indian *Smuts*, but also edited a critical supplement to 'Fungi of India' by Butler and Bisby. He also published a number of papers on Indian Rusts. This period was also significant in that he had developed a small but devoted school of Mycological workers whose critical observations in their various independent capacities later on was marked by the thoroughness with which their training for critical observations was imparted by Dr. Mundkur. Altogether, Dr. Mundkur published a large volume of scientific papers appearing in many journals all over the world, and the climax was the publication of a text-book entitled "Fungi and Plant Diseases" in 1949. A notable recent publication on the Ustilaginales of India published by the Commonwealth Mycological Institute is to be considered as a landmark in this field.

From 1947 to 1952 he served in an advisory capacity as Deputy Director of Plant Protection, a Department born in the wake of Indian Independence. His pioneering work in this field will long be remembered with gratitude in this country. For a short period of a little over one year, from 1952 till his demise at Poona, he was the first occupant of the newly created Chair of Botany at the Poona University. I recall from one of his personal letters with what a high degree of humility he accepted the post—a very admirable quality in a senior scientist! I also recall with what great enthusiasm he had planned to go to Europe in 1951 on a 'Mycological tour', but that was not to be, since he had already taken ill then. Professor Mundkur was elected in 1950 as President of the Botany Section of the Science Congress Session at Bangalore. Among his other contributions to the scientific community in India are his creative effort in bringing into being the Indian Phytopathological Society and the taking over in its initial stages the editing of its official organ, the *Indian Phytopathology*.

Prof. Mundkur's scientific career was marked by thoroughness and although he was characterised by varying moods and what appeared to be a hypercritical nature, what was most characteristic of the man, as I saw it, was that he had beneath this exterior a genuine interest and ungrudging appreciation of sound scientific work, whichever quarter it came from, and indeed, this feeling had reached such a tempo that he had no time for any one who had not wholly adopted a scientific career as his life's mission.. Prof. Mundkur is survived by his wife and two sons, to whom we offer our most sincere sympathy in their loss.

T. S. SADASIVAN.

RESEARCH INFORMATION SERVICE

THE Research Information Service, 53, Nassan Street, New York 38, N.Y., issues periodically bulletins listing translations of patent applications and other scientific literature which are free of charge. The latest Bulletin No. 72 containing eleven pages of abstracts and entitled "Plastics and Synthetic Rubber", contains four sections. Section I is devoted to silicones and related compounds. An interesting example of the reports offered in this section is No. 6083, "Process for Limiting Chain Length and Degree of Cross-Linkage in the Polymerization of Silicone Products" (Siemens-Schuckertwerke, November 1951, $7.50), which describes methods for manufacturing products with good, easily controllable properties from component mixtures of the starting material without the need for separating mono and di-compounds.

Section II, which pertains to Vinyl and Ethylene Compounds, features a "Process for Manufacturing Polyethylene Shapes" (Basf, May 1951, $6.00), which enables the manufacture of sheets of any desired thickness, films, trays, gaskets and other shapes that are free of bubbles and are fast to boiling, in addition to titles dealing with stabilization of polyvinyl acetal, emulsion polymerization, and other topics.

Novel processes for producing oil-modified polystyrene resins and styrene copolymers are described in Section III. Section IV, Elastomers, is highlighted by Report 6094, which proposes new fillers for silicone rubber. These are said to yield remarkable increases in the tensile strength of the end products, "Process for Manufacturing Shapes from Natural or Synthetic Rubber and other Elastomers" (Degussa, November 1951, $6.50). Other Reports in this Section disclose an important new Bayer process based on a di-isocyanate-modified polyester using glycols as vulcanizing agents (Report 6055, $65.00) and an Austrian patent for improving the adhesion of synthetic rubber to textiles (Report 6095, $14.00).

A noteworthy example from Section IV, Cellulosics and Related Compounds, is a translation of an invention by Vereinigte Glanzstoff-Fabriken which makes it possible to obtain from viscose a leather-like material of considerably higher abrasion resistance than natural chamois and equal absorbency (Report 6097, November 1951, $21.50: "Process and Apparatus for the Manufacture of a Leather Substitute from Viscose"). A solvent and plasticizer for acrylonitrile polymer which surpasses known agents in stability, solvency, and physical properties and offers the advantage of a low dissolving or gelatinizing temperature is described in Report 6100, which is listed under Section VI, Acrylics, Phenolics and Polyesters (Roehm & Haas, December 1951, $6.50). Extremely valuable data are found, too, in the last section of Bulletin 72 entitled "Miscellaneous Processes". In first place we find an abstract of a Dynamit A.G. patent application dated January 1952 on a process which yields bubble-free, transparent casting resins representing polyaddition products of very high storage stability (Report 6102, $27.00).

The selection comprises altogether 44 Reports, all of which are abstracted and listed with patent application number and other pertinent bibliographic information as well as prices.

Bulletin No. 71 entitled "Inorganic Chemicals" consists also of 4 sections—Sulphur and Sulphur Compounds—Chlorine and Chlorine Compounds—Miscellaneous manufacturing processes and articles from Russian Scientific Journals.

ELECTRONIC WEATHER FORECASTER

A NEW calculating machine, specially designed to deal with problems of accurate and rapid weather forecasting, has recently been developed at the Institute for Advanced Study, Princeton, under the direction of Prof. J. von Neumann.

Nicknamed "Maniac", the machine contains about 2,000 radio tubes and completes computations with greater speed than any previously built calculating machine.

Simultaneously, the Institute for Advanced Study is modifying the techniques of weather forecasting in order to be able to use the mathematical potentialities of the new machine. Weather forecasters, for example, have been using equations which comprise great air masses; but these masses have been dealt with as isolated units. The new equations devised for "Maniac" deal with much greater units. They comprise the whole atmosphere upto an altitude of 12 miles, and deal with this air mass as if it were built up of imaginary "boxes", each with a volume of 240 cubic miles.

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MICROTONAL VARIATIONS IN FREQUENCIES IN KARNATIC MUSIC-II

The present note gives the results of measurements made on the oscillograph records 12, 13 and 15 which confirm, in a general way, my previous observations.[1] The measurements were made with a Hilger travelling microscope reading to one-thousandth of a millimetre. The procedure was to take the scale readings for every five waves, first on the *raga* curve and then on the curve for the time-base-vibrator and compare the frequencies from the values of the wavelength. This ensured elimination of errors due to mechanical defects involved in the process of recording, and also enabled one to know the exact instant when changes in the frequency took place and the duration for which such changes persisted.

The results are shown by the plot of these curves 12, 13 and 15. They are deduced from a second test of records taken after retuning the violin. (To understand the curves, please read from *right* to *left*).

No. 12, *Begada 'Da'* (Repeat of Record No. 5) was played on the *Pa* string, the frequency of the retuned open string having been found as $604 \pm 1{\cdot}5$. The continuous curve represents the variations in this note, *Da*. It starts with 603 c/s., rises to 691; drops to 661, rises again to 686 and finally drops to 603. At the time of the experiment, it was noted "phrase probably repeated twice". This is clearly confirmed by the second rise from 603 to 664 when the camera was shut off. The variation in *Da* is from R.F. 5/3 to 12/7, (689 c/s., *Pa* being 3/2), confirming the existence of the quarter-tone 36/35 in Karnatic Music.

Curve 13 was the play of *Saveri 'Ri'*. This was a repeat of Record 7, which was not originally measured owing to some extraneous dis-

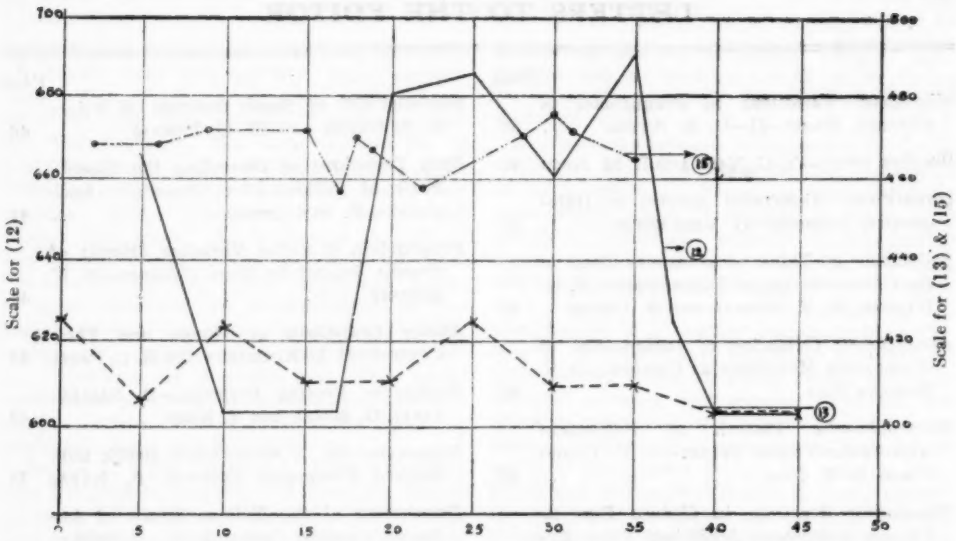

FIG. 1. Frequency variation in Karnatic Music notes : (12) *Begada Da* ; (13) *Saveri Ri* ; (15) *Thodi Ga.*

turbance which had produced violent distortions as noticed in the Report of the Director, National Physical Laboratory, London. This note was played on the *Sa* string and the curve should be read against the scale 400 to 480. It starts at 403 c/s., rises up to 411, shoots up to 425, drops to 411 and goes up to 426 twice. This *fairly* confirms the variation (gamaka) of *Ri*, from R.F. 25/24 to 16/15 (430 c/s.), suggested by analogy in reference to the variation in Saveri '*Da*'.[1]

Record 15 was the first play of *Thodi 'Ga'*, also played on *Sa* string. It is apparent from the plotted curve (15) that the note is in *gamaka*, varying from 457 to 477 c/s.; i.e., from a point above R.F. 10/9 to R.F. 7/6 (470 c/s.), and a little beyond, *Sa* being 1 ; the *veena* technique of the note would lead us to postulate it as from R.F. 10/9 to 7/6.

The records were analysed for me on the new basis, in the Physics Laboratory of the Mahakoshal Mahavidyalaya, Jabalpur.

Mylapore, Madras, C. S. AYYAR.
January 5, 1953.

1. *Curr. Sci.*, Aug. 1949, **18**, No. 8, p. 272 *et seq.*, and "Grammar of South Indian (Karnati.) Music" (Second Edition, 1951), by C. S. Ayyar.

BROCKEN BOWS

THE Brocken bows or anti-coronas are spectrum coloured rings seen around the shadow of one's head in natural clouds, the sun being at the back. These rings are formed by the backward selective scattering of light of different wavelengths by the water-drops in the cloud. Mierdel[1] was the first to observe this phenomenon in artificial clouds by the use of a periscope. His results were used by Hulst[2] in his theoretical study of the formation of anti-coronas.

We have been able to reproduce this phenomenon in the laboratory in the following manner. A large cloud chamber (flask) of about 20-litre capacity was illuminated by a strong beam of white light. A small convex mirror was introduced in the path of the beam of light between the source and the cloud chamber, with its reflecting surface towards the flask. The mirror was kept inclined at 45° to the incident beam, so that a diminished image of the flask could be seen in the mirror from a transverse direction. When a cloud of a suitable size was formed in the flask by sudden expansion, the image of the cloud in the convex mirror was found to consist of a dark shadow of the mirror, surrounded by a series of coloured rings. Very often two or three orders of rings of same wavelength could be observed in a given cloud.

The first or second order rings are often obscured by the shadow especially for clouds of drops having radii greater than 3·5 μ.

The angular apertures of Brocken rings (anti-coronas) of a given colour were determined by a sextant and the necessary correction due to the curvature of the convex mirror in which the rings are observed, was made. The radius of the drops in a cloud was determined by observing the size of corona dark rings, seen in a cloud, when light from a strong monochromatic source (sodium lamp) passes through it.[3] A few typical results for the first order Brocken rings of red colour, which were seen outside the shadow, are given below in Table I.

TABLE I

(Experimental results)

a in μ	α	θ	$\alpha \sin\theta$
2·68	24·67	6° 1′	2·584
2·82	25·90	5° 57′	2·686
3·05	28·05	4° 56′	2·414
3·36	30·90	5° 11′	2·793
3·43	31·50	4° 11′	2·298
		mean	2·555

TABLE II

(Theoretical results)

a' in μ	α'	θ'	$\alpha' \sin\theta'$
2·63	24	6° 30′	2·717
2·84	26	6°	2·717
3·07	28	5° 30′	2·684
3·40	31	5°	2·703
3·51	32	4° 50′	2·698
		mean	2·704

[a = radius of drops in microns, $\alpha = 2\pi a/\lambda$, λ being the wave-length and is taken as 6800 A.U. in these observations, θ = angular aperture of the radius of the Brocken rings. The dashed letters in Table II refer to the theoretical values of the same quantities.]

The anti-coronas could be explained on the basis of Mie's theory[4] of scattering of light by spherical particles. The determinations of the intensity functions for different angles and for different drop sizes of proportionally large radii, involve very extensive and laborious calculations. Ruedy[5] has, however, shown that for such large-sized drops, the diffraction and the scattering theories give nearly identical results. Hence the intensity values of light diffracted by water-drops in different backward directions and different drop sizes were evaluated on the basis of Ruedy's formula. From these results, the angles of the first maxima of light intensity of a given wavelength are determined. These values are given in Table II.

It can be seen that the observed angles for the Brocken rings are in fairly good agreement with the theoretical values. The last column indicates that the theoretical values of $\alpha \sin\theta$ is nearly constant, and the experimental ones also appear to be nearly so. The deviations in the observed values of $\alpha \sin\theta$ from the theoretical values may be due to small errors of measurement. Assuming the theory as correct, we find that $\alpha \sin\theta = 2{\cdot}704$.

This formula therefore provides a measure of the radius of the drops in a cloud and is similar to the one used in corona method. It may be noted that Hulst[2] arrived at the conclusion that the diffraction theory is not adequate to explain the changes in the size of the Brocken rings with the variation in the size of the drops. This conclusion may be due to insufficient or uncertain data of the previous observers.

A detailed account of this work will be published elsewhere in due course.

Gujarat College, Ahmedabad, *September* 9, 1952.

Y. G. NAIK,
R. M. JOSHI.

1. Mierdel, F., *Beitrage Zur Physik der Freien Atmosphäre*, 1919, **25**, 8. 2. Van de Hulst, H. C., *J. Opt. Soc. Am.*, 1947, **37**, 16. 3. Humphrey, *Physics of the Air*, 528. 4. Mie, G., *Ann. d. Phys.*, 1908, **25**, 377. 5. Ruedy, R., *Canad. J. Research*, 1944, **22**, 53.

ULTRA-VIOLET ABSORPTION SPECTRA OF HALOGENATED TOLUENES

IN continuation of the previous work on the absorption spectrum of p-chloro-toluene[1] the author has photographed the absorption spectra of *o*- and *m*-chloro toluenes and ortho-bromo-toluene in vapour state. The spectra of ortho-chloro and bromo-toluenes have been found to possess sharper band heads than the spectrum of *m*-chloro toluene. The strong bands located at ν 36877, 36615 and 34846 are taken as 0-0 bands for *o*-chloro, meta-chloro and ortho-bromo-toluenes respectively. The observed ground and excited state frequencies for the three molecules are as follows:

Ortho-chloro-toluene

ν''	161, (162),	245, (247),	262, (362),	677, (675),	749, (745),	808 (808)
ν'	484,	644,	769,	902,	1069,	1182

Meta-chloro-toluene

ν''	182,	236				
	(187),	(231),				
ν'	245,	454,	785,	962,	1205	

Ortho-bromo-toluene

ν''	152,	239,	313			
	(152),	(236),	(297)			
ν'	478,	603,	771,	960,	1014,	1181

The values given in the brackets are Raman frequencies taken from Megat.[2]

Further details of the assignments will be published elsewhere.

Andhra University, G. VISWANATH.
Waltair,
December 15, 1952.

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ESTIMATION OF THIOSEMICARBAZONES USED IN THE CHEMOTHERAPY OF TUBERCULOSIS

THIOSEMICARBAZONES of some aromatic aldehydes have been shown to be highly active *in vitro* and *in vivo* against tuberculosis by Domagk *et al.*,[1] Domagk[2] and Hoggarth *et al.*[3] An attempt has been made in this paper to identify and estimate this group of drugs in pharmaceutical preparations. One of these compounds, P. succinyl-amino-benzaldehyde thiosemicarbazone sodium hydrate was sent to this laboratory for identification and estimation. Heilborn, *et al.*,[4] have shown that these compounds have the characteristic property of absorbing ultra-violet light. The region in which there is maximum absorption by these drugs is approximately the same as for vitamin A (320 mμ). Employing a special combined filter of liquid and glass which has been used in this laboratory for the estimation of vitamin A with the Lumetron Photometer 402 E.F., the absorption was found to be very much more than for the other thiosemicarbazones. On account of this very high absorption, extremely high dilutions of the drug have to be used for its estimation.

A graph connecting the concentrations with the corresponding optical densities was drawn after measuring the percentage transmissions of varying concentrations of the drug. This was found to be a straight line in the range of concentrations studied (i.e., 1 mg. in 10,000 c.c. to 10 mg. in 10,000 c.c.). The extinction coefficient is given by the following equation.

$$E^{1\%}_{320\ m\mu} = 2{,}000.$$

In view of the high extinction coefficient, this property of absorption can be employed for the estimation of the drug in very small quantities, occurring in body fluids after the administration of the drug.

The authors' thanks are due to Dr. M. D. Chakravarti, Director of the Laboratory, for his kind interest in the work.

Central Drugs Laboratory, N. K. IYENGAR.
Calcutta-12, H. K. BISWAS.
November 7, 1952. S. DUTTA.*

1. Domagk, G., Behnisch, R., Mietzsch, F. and Schmidt, H., *Naturwissenschaften*, 1946, **33**, 315. 2. Domagk, G., *Nord. Med.*, 1948, **39**, 1322. 3. Hoggarth, E., Martin, A. R., Storey, N. E., and Young, E. H. P., *Brit. J. Pharmacol.*, 1949, **4**, 248. 4. Heilborn, I. M., Johnson, A. W., Jones, E. R. H. and Spinks, A., *J. Chem. Soc.*, 1942, 727. 5. Iyengar, N. K. and Biswas, H. K., *Ind. Jour. Med. Res.*, July 1949, **37**, 311.

* Deputed by the Bhopal Government for training.

ATMOSPHERIC OXIDATION OF IODIDE—USE OF AMMONIUM MOLYBDATE AS CATALYST

THE reaction, $4\,HI + O_2 \rightarrow 2\,H_2O + 2\,I_2$, is extremely slow in neutral medium and becomes more pronounced at higher hydrogen-ion concentrations. Ammonium molybdate was found to catalyse[1,2] many reactions involving the oxidation of iodide ion. Now, the above reaction is also shown to be catalysed. The reduction of ammonium molybdate by iodide at high acidities was also known.

In the present work, 100 c.c. of HCl ranging between 0·1 N and 6 N and 10 c.c. of 10% KI solution were taken in glass-stoppered bottles and the atmospheric oxidation was studied (*a*) without and (*b*) with 10 drops of 10% aqueous solution of ammonium molybdate and some illustrative results are given in Table I. Again, in the same concentration range of HCl the reaction between ammonium molybdate (between 5 drops and 10 c.c.) and 10 c.c. of 10% KI solution was studied out of contact with air and in an inert carbon dioxide atmosphere. The liberated iodine under different conditions was titrated against standard 0·02 N sodium thiosulphate solution from a micro-burette.

Whilst the amount of iodine liberated in an inert atmosphere is appreciable at larger molybdate and acid concentrations, it is negligibly small under the conditions where the catalytic aspect was studied. The results in the table show a definite positive catalysis at low acid

Time in hrs.		1		2		3		4	
Vol. of $Na_2S_2O_3 \times 10$ (in c.c.) / Strength of HCl		(*a*)	(*b*)	(*a*)	(*b*)	(*a*)	(*b*)	(*a*)	(*b*)
0·1 N	..	2·0	4·0	4·0	6·0	5·5	8·0	7·5	10·0
0·5 N	..	4·0	5·0	7·5	9·0	12·0	14·0	16·0	17·5
1·0 N	..	6·0	6·0	8·5	8·5	13·5	13·5	16·0	16·0
2·0 N	..	8·0	8·3	12·5	12·8	19·0	19·6	..	..
3·0 N	..	12·5	12·7	19·0	19·5	26·0	26·5	..	..

concentration but the same was not observed above 1 N. This may, perhaps, be due to the anionic and cationic behaviour of Mo on either side of the iso-electric point.

My thanks are due to Prof. B. Prasad for his kind advice in the work.

Dept. of Chemistry, D. V. Ramana Rao.
Ravenshaw College, Cuttack,
November 11, 1952.

1. Kolthoff and Sandell, *Quant. Inor. Ed. Analysis*, 1947 Ed., 624, 630. 2. Ramana Rao, D. V., *Curr. Sci.*, 1952, **21**, 244.

ELECTROPHORETIC PATTERN OF POLYVALENT ANTI-SNAKE-VENOM SERUM

Anti-body proteins of horse serum are now commonly known to reside in a fraction possessing an electrophoretic mobility between the normal serum gamma-globulins and the lipid-rich beta-globulins. This fraction, however, has been designated differently by different workers from time to time. Van der Scheer and Wyckoff[1] named it the T-Component while studying tetanus anti-toxic serum. Kekwick and Record[2] named it beta-2-component while studying diphtheria anti-toxic serum, and Deutsch *et al.*,[3] designated it as gamma-1-globulin to distinguish it from the normal serum gamma-2-globulin. The same anti-body component has, thus, received different names from different authors.

Nevertheless, the electrophoretic patterns of these different anti-toxic sera indicated clearly that during hyper-immunization of horses with bacterial toxins a new component showed itself frequently as a distinct peak in the electrophoretic pattern. We prepare a polyvalent anti-snake-venom serum in horses with simultaneous injections of a mixture of venoms of all the four poisonous snakes of India according to the method of Hazra.[4] We were interested to find out whether such a polyvalent anti-venene would show an electrophoretic pattern similar to that shown by the common anti-toxic sera, or would be different.

We have, therefore, photographed, the electrophoretic patterns of (*i*) normal horse serum, (*ii*) natural polyvalent anti-snake-venom horse serum, (*iii*) diphtheria anti-toxic horse serum pseudo-globulin fraction, and (*iv*) polyvalent anti-snake-venom horse serum pseudo-globulin fraction in our Adam-Hilger Electrophoretic apparatus. Samples (*iii*) and (*iv*) were prepared by ammonium sulphate fractionation procedure of Gibson[5] as modified by Murdick.[6] These are shown in Figs. 1-4.

FIG. 1. FIG. 2.

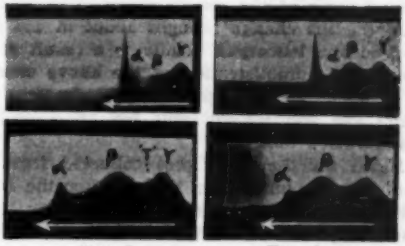

FIG. 3. FIG. 4.

FIG. 1. Normal horse serum.

FIG. 2. Natural polyvalent anti-snake-venom horse serum.

FIG. 3. Diphtheria anti-toxic horse serum pseudo globulin fraction.

FIG. 4. Polyvalent anti-snake-venom horse serum pseudoglobulin fraction.

The pattern of the polyvalent anti-snake-venom serum differed from those of both the normal serum and the diphtheria anti-toxic

serum. There was in the anti-snake-venom serum considerable increase in the beta-component, but no distinct peak could be found separate either from the beta- or from the gamma-peak. The diphtheria anti-toxic pseudo-globulin fraction, on the other hand, showed a small but distinct peak associated with the gamma-globulin component. The polyvalent anti-snake-venom horse serum, thus, differed from the anti-toxic horse serum.

Dept. of Anti-toxins and Sera, Haffkine Institute, Bombay-12, *November* 12, 1952.

D. C. Lahiri.
S. S. Rao.

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PHAGOCYTIC RESPONSE IN GUINEA PIGS TO CERTAIN INDIGENOUS MEDICINAL PLANT EXTRACTS

In the *in vitro* experiments adopted for the purpose of studying phagocytic response of human blood leucocytes to *Micrococcus citreus* in presence of the aqueous extracts of the leaves of *Murraya koenigii* and the nuts of *Areca catechu*, it was reported[1] that whereas the former enhanced the phagocytic activity, the latter had a depressing effect. In this paper are presented some of the results obtained *in vivo* on studying the change brought about in the phagocytic and leucocytic counts as a result of the parenteral administration of the above extracts to female guinea-pigs of approximately the same age and weight, and fed on a uniform standardised diet.

Blood for the study was collected from the ear of the animal prior to and after the intramuscular administration of the extracts tested and every time an untreated animal was kept as control. For the total leucocyte count the pipette was filled with blood directly from the ear lobe. Smears for the differential count (made on 300 leucocytes) were also made from the untreated blood; for the phagocytic count, however, the blood was collected in citrate (final citrate concentration in blood being 0·125 M.).

In Table I are presented the results obtained on administration of 1 ml. every day for 5 consecutive days of a 20% aqueous extract (cold, 48 hr. extraction) of the leaves of *Murraya kœnigii* to the test animal. The animals were also tested a week after the injections were stopped, i.e., on the 14th day after the commencement of the injections.

TABLE I

Animal	Time of test	Leucocytes per cmm.	Polymorphonuclears %	Mononuclears %	Phagocytic index	% Reacted leucocytes
		A				
Test	Initial	11,200	25·3	74·7	10	65
Control	..	12 600	10·0	90·0	8	86
Test	Immediately after 5 injections	9,660	28·0	72·0	27	100
Control	..	13,420	14·0	86·0	12	89
Test	8 days after stopping injections	8,300	28·0	72·0	2	33
Control	..	9,200	7·0	93·0	5	78
		B				
Test	Initial	10,740	20·3	79·7	4	55
Control	..	12,600	10·0	90·0	8	86
Test	Immediately after first 5 injections	6,120	41·0	59·0	39	99
Control	..	13,420	14·0	86·0	12	89
Test	Immediately after rest period and another 5 injections	20,800	40·3	59·7	6	75
Control	..	9,200	7·0	93·0	5	78

It will be noticed from the results presented above that the *M. kœnigii* leaf extract can not only raise considerably the phagocytic index but results in mobilising a greater number of leucocytes to take part in phagocytosis. This beneficial effect, however, does not seem to last long as the tests made on the 14th would indicate. It may also be noted that the variations in the total and differential leucocytic counts were not very appreciable in both the test and control animals.

The results obtained on injecting the test animal with 1 ml. every day for 5 consecutive days of a 10% aqueous extract of the nut of *Areca catechu* (cold, 48 hr. extraction) are presented in Table I B. The phagocytic response of the same test animal was again studied after a 2-day rest period followed by the dose, specified above, for 5 more consecutive days.

It is interesting to note that the overall favourable influence of the Areca nut extract in the phagocytic reaction of the test animal is accompanied by a change in the total and differential counts and that this change consists of a decrese in the total and an increase in polymorphonuclears present. When, however,

treatment with the Areca nut was continued on the same animal after a brief rest period, the phagocytic index had fallen by 85% of that recorded after the initial 5-day treatment. Furthermore, marked leucocytosis in the test animal was evidenced at the end of this period even though the normal range observed in guinea-pigs may be as variable a figure as between 5,000-23,000 leucocytes per cmm.[2] Unlike the unfavourable effect exerted by Areca nut extracts on human leucocytes,[1] there was absolutely no distortion of the guinea-pig leucocytes, nor, for that matter, were any toxic effects apparent in the treated animal, contrary to what was expected as a result of the *in vitro* studies made with human leucocytes.

Pathological Laboratories, Rajul Broker.
Sir P. Mehta Road, K. T. Gajjar.
and
St. Xavier's College, Bombay, J. V. Bhat.
November 12, 1952.

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m-CHLORO PHENYL CYANAMIDE

The characteristic property of cyanamide and substituted cyanamides is the ease with which they are found to polymerise. Cyanamide polymerises to dicyandiamide, with very great ease in acid or alkaline solution, but not in alcoholic or neutral media. Substituted cyanamides also polymerise under varied conditions. The introduction of positive groups into the molecule of cyanamide hastens polymerisation.[1] The present work was undertaken to study the chemistry of *m*-chloro phenyl cyanamide in the light of the above discussion.

m-chloro phenyl cyanamide was prepared by desulfurising *m*-chloro phenyl thiourea, with lead acetate in alkaline medium and the product was separated by acidifying it with acetic acid in cold.[2] Desulfurisation of *m*-$Cl.C_6H_4.NH.CS.NH_2$ with $NaBrO_3$ or $NaIO_3$ according to the method of Capps and Dehn[3] gave very poor yields. It was also obtained in quantitative yields by a modification of Pierron method.[4]

It is a colourless, needle-shaped, crystalline solid, insoluble in H_2O, readily soluble in EtOH, Et_2O, and C_6H_6. It melts at 89·5° (uncorrected). It forms the hydrochloride, *m*-$Cl.C_6H_4.NH.CN.2\,HCl$. In neutral medium it does not suffer any hydrolysis. In alkaline medium, it hydrolyses upto 15·94%. In acid medium the substituted urea is formed. With mercuric chloride it gives *m*-$Cl.C_6H_4.NH.CN.2\,HgCl_2$. All attempts to prepare the nitroso derivative have failed. It has been estimated as its silver salt in the presence of acetic acid.

The para isomer of this has been studied by Sahasrabudhey and Krall.[1]

Further work on this compound is in progress and full details will be published elsewhere.

The authors' thanks are due to Prof. M. L. Schroff for his keen interest in the work and for the facilities given.

Chemical Laboratories, K. S. Srinivas.
Birla College, Pilani, R. D. Gupta.
November 12, 1952.

1. Singh, B., Hans Krall and Sahasrabudhey, R., *J. Ind. Chem. Soc.*, 1946, **23**, 375; Sahasrabudhey, R. and Hans Krall, *Ibid.*, 1942, **19**, 343. 2. Kurzer, F., *Org. Syntheses*, 1951, **31**, 19. 3. Cappa, H. H., and Dehn, W. M., *J. Amer. Chem. Soc.*, 1932, **54**, 4301. 4. Paul Pierron, *Bull. soc. chim.*, 1906 (III), **35**, 1197.

DOUBLE BETA DECAY OF Te^{130} AND Se^{82}

Inghram and Reynolds[1] found that xenon from tellurium ore was richer in Xe^{130} than that obtained from atmosphere. They attributed this isotopic abundance to the double beta decay of Te^{130}. Fireman[2] also reported the results of a rather difficult β-coincidence counting experiment on the decay of Sn^{124} to Te^{124} by simultaneous emission of two negative beta particles with a half life between 4×10^{15} and 9×10^{15} years. Reinvestigating the above, Fireman and Schwarzer[3] reported, rather dubiously, a much longer half life for the process than the one reported earlier. However, they were not sure whether their experiment confirmed the presence of double beta decay of Sn^{124}.

With a view to decide whether Te^{130} decays by the double beta decay process or in steps, $\left[Te^{130} \xrightarrow{\beta-} I^{130} \xrightarrow{\beta-} Xe^{130}\right]$ the first step having a long half life, five pounds of pure tellurium was converted to the water-soluble salt and 20 mg. of iodine and 100 mg. of bromine co-precipitated in it as the silver salt. After removal of bromine, iodine was deposited as AgI and measured in a suitable end-window G-M Counter.

A similar experiment was repeated with 5 lb. of selenium. In this case 20 mg. bromine and

100 mg. iodine were co-precipitated and bromine recovered by digesting the silver halides with potassium dichromate and sulphuric acid. The silver bromide deposited on a plate was measured as above.

In both cases the result was negative, the increase in the number of counts, if any, being well within the statistical fluctuations of the background. It is therefore concluded that either the half life of $Te^{130} \rightarrow I^{130}$ and $Se^{82} \rightarrow Br^{82}$ is more than 10^{17} years or that they decay by simultaneous emission of two β particles. A detailed report on the detection of double beta decay in Te^{130} will be published elsewhere.

The author is indebted to Prof. G. T. Seaborg for suggesting this experiment which was carried out under his guidance.

Dept. of Chemistry, HARI D. SHARMA.
University of California,
November 26, 1952.

1. Inghram, M. G. and Reynolds, J. H., *Phys. Rev.*, 1949, **76**, 1265. 2. Fireman, E. L., *Ibid.*, 1949, **75**, 323. 3. — and Schwarzer, D., 1952, **86**, 451.

THE REACTION BETWEEN HNO_2 AND HI

ADOLF ECKSTADT[1] attempted in 1901 a study of the kinetics of the reaction between nitrous acid and hydrogen iodide. His observation was that the reaction took place very rapidly at first but soon slackened. Work done by us has confirmed the above observation.

The initial rapidity of the reaction and a subsequent slackening of its rate *inter alia* made us investigate the possibility of existence of chain mechanism in this reaction.

At concentrations of N/50 $NaNO_2$ and KI with an excess of N/4 sulphuric acid it was possible to measure the reaction from the second minute onwards until which time it was immeasurably fast.

Coating the vessel with paraffin wax neither retarded nor accelerated the reaction. Titania and silica also had no effect on the reaction. With acetone, ethyl alcohol, *d*-mannitol, *d*-glucose, glycerol, vanillin, benzaldehyde, chloral hydrate, manganous sulphate, sodium chloride, and potassium chloride there was no effect on the rate of the reaction. With hydroquinone there was the difficulty of interference due to the formation of an intermediate compound and hence the result was inconclusive. With resorcinol, a permanent red colour developed and so it vitiated correct determination of the end point. But qualitatively there was no marked retardation in the rate of the reaction as could be seen visually. Potassium chlorate had a slight accelerating effect on the rate of the reaction.

The compounds sodium acetate, sodium citrate, potassium oxalate, ammonium oxalate and potassium tartrate had a very marked retarding effect on the rate of the reaction depending on the amounts added, even with N/10 solutions of $NaNO_2$ and KI in presence of sulphuric acid of concentrations ranging from N/10 to 6 normal and the rate of the reaction could be measured.

Taking the above observations together with others pertaining to the rate of reaction, yet to be published, there is ample evidence to show that there is no chain mechanism in this reaction. On the other hand there is a positive evidence that the uniformity of the rate of the reaction and its dependence on the amount of the alkali salts of weak organic acids present is due simply to the buffer action of those salts in excess acid.

A fuller study of the chemical kinetics of this acid catalysed reaction is being continued and details will be published elsewhere.

I thank Dr. C. V. Suryanarayana for his valuable guidance.

Dept. of Chemistry, S. SAMBASIVAN.
Annamalai University, Annamalainagar,
December 17, 1952.

1. *Zeit. anorg. chem.*, 1901, **29**, 51-94.

ESSENTIAL OIL OF *SESELI INDICUM* W. & A.

Seseli indicum, W. & A., (Sans. Vana-yamani) belongs to the N. O. Umbelliferæ. The use of this plant is mentioned in the indigenous systems of medicine for several purposes.[1,2] The only work on its chemical investigation seems to be the isolation of the three crystalline substances Seselin, Bergaptene and Isopimpinellin from its fruits by Bose and Guha[3] and Spath and co-workers.[4] In the present study, the nature and composition of its essential oil was investigated. The oil (average yield 2·5%), obtained by steam distillation of the finely powdered dry seeds of this plant, is limpid and almost colourless (developing a slightly yellowish shade on keeping or heating) having an aromatic odour and clove-like taste. It is a

thin oil, acidic in nature, and showing d_{32} 0·8905; $\alpha_D^{32} + 34·7$; n_D^{32} 1·48214; Acid value 3·1; Ester value 30·0; Sap. value 33·1; and Sap. value after acetylation 64·6. Other physico-chemical properties of the oil have been studied and fractionation effected at reduced pressure. A study of its composition reveals that it consists of 45-50% terpenes (mainly limonene) besides an appreciable quantity of sesquiterpenes and sesquiterpene alcohols. The presence of some other alcohols and esters is also indicated. Acids (about 2%) and lactonic and phenolic bodies (1·5%) have been found to be present in it. Further, on hydrolysis by alcoholic caustic potash other acids have been isolated from the essential oil. Work is in progress and the details will appear in due course.

Dept. of Chemistry, G. S. Gupta.
Muslim University, Aligarh, M. O. Farooq.
December 17, 1952.

1. Watt, G., *A Dictionary of the Economic Products of India*, 1893, **6**, Part II, 545. 2. Kirtikar and Basu, *Indian Medicinal Plants*, 1918, 626. 3. Bose, P. K., and Guha, N. C., *Science* and *Culture*, 1936, **2**, 326. 4. Spath, Bose, Matzke and Guha, *Ber.*, 1939, **72B**, 821.

EASY TECHNIQUE OF DISSECTING THE MOUTH-PARTS OF SUCKING-LICE (*INSECTA : ANOPLURA*)

The mouth-parts of sucking-lice, which consist of a few rod-shaped structures contained in a membranous sheath, have evoked considerable morphological interest since long. They, however, present considerable technical difficulty in dissection, partly because of their minute size and partly because of the fact that as the sheath is ruptured, the internal rods float away and escape.

I found the following method very successful with the cow louse, *Linognathus vituli* (Linn.): The insect is placed on a slide in a drop of normal saline. Incision is made on the ventro-lateral borders of the head with a sharp needle. The dorsal integument is then removed from the head with a pair of fine forceps. The membranous sac, with the contained piercing rods, floats out. The sac is then taken out, placed on another slide (whose surface was previously coated with Mayer's albumen) and kept aside for an hour or two until it is fully dried up. A drop of 10 per cent. KOH solution in water is then added. After the dissolution of the soft tissues, which takes a quarter to half an hour, the excess KOH is removed by means of a filter-paper and neutralised with drops of acidulated water. It is then irrigated with upper grades of alcohol, starting with lower strength, and stained with eosin in 90 per cent. alcohol, the excess being removed with a filter-paper. The material is then cleared in clove oil and mounted in Canada balsam. The whole operation is done under the low power of a stereoscopic binocular.

This work was carried out in the Zoological Laboratory, University of Calcutta, under the guidance of Shri D. Mukerji to whom I am thankful.

Forest Research Inst., P. Sen Sarma.
Dehra Dun,
July 29, 1952.

PROPAGATION OF THREE VARIETIES (HORTI) OF PRUNUS SPECIES BY STEM CUTTINGS

Although stem cuttings of inferior varieties of plums root easily,[1-5] the varieties Early round, Howe and Kelsey have not been reported to lend themselves to this method of propagation. The author, therefore, tried to propagate them by cuttings with the help of growth substances to introduce a quick and easier method of propagation.

Cuttings, nine inches long, were taken from dormant shoots of the varieties mentioned above. Shoots of medium vigour were used as the vigorous ones are considered to be less desirable, 6. The cuttings were treated with 10, 20 and 30 ppm. solutions of Indole butyric acid for 24 hours. The untreated cuttings were dipped in tap water for similar duration. They were washed with tap water after treatment, and planted in sand with two-third of the total length under sand. The pots were watered regularly.

Formation of roots was observed 14, 18 and 23 weeks after planting in Early round, Howe and Kelsey respectively. All the treated as well as untreated cuttings produced callus which was more developed in the former. The percentage of cuttings that struck roots increased with the concentrations of Indole butyric acid, being lowest in 10 ppm. and highest in 30 ppm., 66, 68 and 22 per cent. respectively, in Early round, Howe and Kelsey varieties. Very small rootlets (3 mm. long) were observed in two untreated cuttings of Early round. These failed to elongate further. The treated cuttings which had developed roots showed vigorous shoot formation and the leaves on such roots were more numerous and well developed.

Grateful thanks are due to Dr. L. B. Singh for his continued interest in the work and many helpful suggestions.

Fruit Research Station, Saharanpur, U.P., India, *July* 31, 1952. N. N. DIKSHIT.

1. Baily, L. H., *Standard Cyclopedia of Horticulture*, Macmillan Co., New York, 1950, **3**, 2716. 2. Gourley, J. H., and Howlett, F. S., *Modern Fruit Production*, The Macmillan Co., New York, 1947, 497. 3. Chandler, W. H., *Deciduous Orchard*, Lea & Febiger, Philadelphia, 1947, 322. 4. Hayes, W. B., *Fruit Growing in India*, 246. 5. Naik, K. C., *South Indian Fruits and Their Culture*, P. Varadachary & Co., Madras, 333. 6. Pearse, H. L., *Technical Communication*, No. 20, *Growth Substances and Their Practical Importance in Horticulture*, 1948, 154.

BLISTER LEAF-GALLS OF MANGO AND THEIR CONTROL

THE present investigations were primarily undertaken to study the seasonal history of the pest and to work out suitable remedial measures to control the pest.

Initial infestation is noticed on the new growth during June-July. The Cecidomyiid flies, *Allasomyia tenuispatha* (Kieff), and the minute black wasps belonging to Cynopid family are mainly responsible for the numerous gall formations on the leaf. The infested leaf ultimately turns fibrous and brittle, and presents a very rough surface. If very tender leaves are infested they become crinkled and the entire shoot presents a very characteristic appearance. A single gall is multi-cellular, slightly raised into small hemispherical irruption with a dark crater in the apex, and measures at the base about 0·2 cm. The insects oviposit on the very tender leaves just after their emergence. The galls are generally observed on the fourth day in the form of small minute dark spots which consequently develop into galls in the course of 8-10 days. These studies were made in the laboratory by artificial liberation of the insects on the new mango growth under cage conditions. The observations were also confirmed in the field. The emergence of gall insects was closely related with sharp fluctuations in the atmospheric temperatures. The emergence of the pest invariably coincided with the new growth on the host plants, so that the pest always found favourable conditions for its multiplication. The total life-cycle of the gall insects varied from 180 to 200 days between the months of March-July. Only one adult insect emerged from a single gall.

The older infested shoots on the plant, of the previous season, provided the source of new infection on the plant. However, it was observed that the insects were also capable of migration to the neighbouring plants.

Out of the various insecticides tested 0·2% BHC in the form of Gammexane or Hexidole water suspension spray soon after the plants have put on new growth, gave sufficient protection to the new mango shoots against the pest.

The workers are thankful to Prof. M. S. Mani for the identification of the insects.

Entomological Lab., Inst. of Agriculture, Anand, *August* 7, 1952. H. L. KULKARNY. R. C. PATEL.

STUDIES IN ROOTING RESPONSE

PETIOLES of the detached leaves of the following plants responded to hormone treatment resulting in rooting. *Dolichos lablab* Linn. produced profuse roots in almost all concentrations of β-indolyl butyric acid (5-100 p.p.m.), lower concentrations being preferable. *Canavalia ensiformis* also responded favourably to hormone solutions. In the case of *Ipomœa batatas*, Lamk., aqueous solutions of β-indolyl acetic acid (I. A. A.), β-indolyl butyric acid (I. B. A.) and α-Naphthalene acetic acid (N. A. A.) were tried. Higher concentrations (100 and 50 p.p.m.) of the two hormones I. A. A. and N. A. A., and lower concentrations (10, 5, and 2·5 p.p.m.) of the I. B. A. appear to produce the optimum results. 2·5 p.p.m. of the I. B. A. is the best concentration for rooting.

Dept. of Botany, Ravenshaw College, Cuttack-3, *September* 22, 1952. B. SAMANTARAI. G. MISRA. T. KABI.

ZYGAENODES SP., A REMARKABLE BEETLE WITH STALKED COMPOUND EYES

A SINGLE adult male beetle belonging to the genus *Zygœnodes* Pasc. (Family Anthribidæ : Coleoptera) was collected in November 1951, from Trivandrum. The flying insect was caught and swept down into an open dish on the table by the current of the fan. On examination, the insect proved to be remarkable in the possession of stalked compound eyes (Fig. 1). The eyes are mounted on prominent, short, cylindrical stalks, and the antennæ arise from behind the base of these stalks. The stalks are clothed with very fine, brownish pubescence. The

beetle measures 3·2 mm. in length and 2·1 mm. from eye to eye.

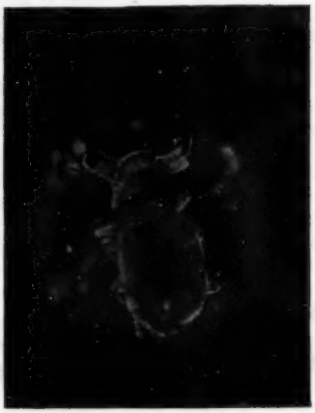

FIG. 1. Photograph of male beetle with stalked compound eyes.

Mr. G. D. Bhasin of the Entomology Department of the Forest Research Institute, Dehra Dun, informs me (*in litt.*,) that this beetle does not conform to the description of any known Indian species of *Zygœnodes* Pasc., and believes it to be new. The males of this genus have stalked compound eyes, while the females are normal.

It is of interest to note that among insects, only the Dipterous family Diopsidæ have stalked compound eyes. The only other section of insects with stalked compound eyes is the anthribid genus *Zygœnodes* Pasc.

Zoology Laboratories, K. K. NAYAR.
University College, Trivandrum,
November 17, 1952.

OCCURRENCE OF THE YELLOW STRAIN OF LAC INSECT *LACCIFER LACCA* KERR. (COCCIDAE) IN DELHI

THE lac insect, *Laccifer lacca*, Kerr., has been observed to occur on *pipal* tree (*Ficus religiosa*) in Delhi throughout the year. During the month of October 1951, certain swarms of larvæ were seen to consist of two types of individuals: about 40% of them were yellow in colour and the rest red. An examination of the lac encrustation revealed both red and yellow female cells on the same twig. Studies of the morphological characters did not show any difference between the yellow and the red larvæ. This observation is quite significant for there is as yet no record of the occurrence of this yellow strain in such large numbers.

A *palas* tree (*Butea frondosa*) was inoculated with the yellow strain in the same month. The individuals on this host were observed to thrive well up to March 1952, but they suffered great mortality during the months of April, May and June probably due to excessive heat and drought. The survivals showed both red and yellow cells in the ratio of 80 to 20. It would appear that the occurrence of a fairly high percentage of yellow strain of the lac insects on *pipal* tree is related in some way to the quality of nutrients available on this host.

Further observations are being carried out in this Department on the yellow strain of lac insect.

Zoological Laboratory, V. KUMAR GUPTA.
Delhi University, Delhi,
December 10, 1952.

FURTHER EVIDENCE FROM FISH DISTRIBUTION OF THE RISE IN SALINITY OF THE RIVER HOOGHLY

IN 1943, the writer placed on record (*Curr. Sci.*, 12, pp. 89-90) the results of an investigation he carried out for the Corporation of Calcutta in 1938 and showed from the distribution of fishes in the River Hooghly that there was a distinct evidence of a rise in the salinity of the river since 1814. More recently, I[1] had occasion to refer to the infiltration of coarser varieties of *Hilsa* in the lower reaches of the river and now Pillay[2] has given an account of the fishery of *Hilsa toli* at Falta (about 80 miles from the mouth of the river), Diamond Harbour (about 69 miles from the mouth of the river) and in the Rupnarain River. The significance of this will be clear from the following facts:—

(1) In Indian waters, *H. toli* is a marine fish and, unlike its congener *H. ilisha* (the famous Hilsa) it is not known to ascend Indian rivers.

(2) Except for 1951 and 1952 seasons, when *H. toli* was not uncommon in the River Hooghly, it was imported to the Calcutta markets during the previous years from Bombay.

(3) *H. toli*, unlike the fishes I reported in 1943, is not a demersal species but is a pelagic form and moves in the surface waters.

The inference that can be drawn from the above facts is that the surface waters of the portions of the river, where *H. toli* is now found, have become more brackish during the

last couple of years. Mr. G. S. Madan, Chief Engineer, to the Commissioners for the Port of Calcutta, in a note, based on surface salinity records at Garden Reach and Cossipore, has informed the undersigned that:

(a) the trends show increasing salinity in recent years; and

(b) slopes of the trend lines get steeper as the dry season advances at Garden Reach, say, this increase in salinity is more rapid in June than in March.

This increase is relatively less at Cossipore which is further upstream.

Correlated with the relatively less increase in salinity recorded at Cossipore is the fact that Pillay did not find any specimen of *H. toli* at Baghbazar (Calcutta) and at Nawabunge (about 18 miles up the river from Calcutta).

One presumption from the above data is irresistible, and that is this. The bottom wedge of heavier brackish waters may have penetrated deeper into the River Hooghly and it will be interesting, both from the academic and utilitarian aspects, to resurvey the river for its fish fauna during the coming dry season and see how far these fishes can serve as indicators of rise in salinity. It will also be of interest to correlate the fish-survey findings with the investigations now being conducted in regard to training works to improve the channels. It is likely that the rise in salinity has so far effected only the channels below the Port of Calcutta, where the result of the accumulative effect of improved channels may be facilitating the influx of the sea-water. In fact, the fishery of *H. toli* at Diamond Harbour, Falta and in the Rupnarain River is very suggestive of such a process. An intensive biological study of the fauna of the River Hooghly as high up as Nadia and of its tributaries may throw flood of light on the behaviour of the River under training works.

Zoological Survey of India, SUNDER LAL HORA.
Indian Museum, Calcutta-13,
December 19, 1952.

1. Hora, S. L., *Symposium on Hilsa and Hilsa Fisheries, Indo-Pacific Fisheries Council* (Mimeo), 1952.
2. Pillay, T. V. R., *Curr. Sci.*, 1953, **23**.

CHROMOSOME NUMBER IN FOUR UMBELLIFERS

IN the present note the author records the chromosome number in *Apium graveolens* Linn., *Carum copticum* Benth., *Pimpinella adscendens* Dalz. and *Daucus carota* Linn.

Pimpinella adscendens Dalz., was collected from Khandala in January when it grows gregariously in dry places. The rest of the material was obtained from plants cultivated in college gardens.

Flower buds of various sizes were fixed in the Navaschin's fluid with a pre-fixation in Carnoy's acetic acid-alcohol-chloroform solution for about ten to fifteen seconds. The usual methods of dehydration and embedding in paraffin were followed. Sections were cut 8 μ to 10 μ thick and stained in Haidenhain's iron-alum-hæmatoxylin which gave satisfactory results.

FIGS. 1, 2, 3, and 4 show the first metaphase plateh in *Apium graveolens* Linn., *Carum copticum* Benth., *Pimpinella adscendens* Dalz. and *Daucus carota* Linn., respectively, × 750.

The chromosome counts were made in the polar views of the first and second metaphases in the pollen mother-cell nuclei. The haploid numbers and the sizes of chromosomes for different plants are given below:—

Tribe	Plant	*n*	Size of the chromosomes
Ammineæ	*Apium graveolens* Linn.	11	Seven large, two medium, and two small
,,	*Carum copticum* Benth.	9	One large, four elongated, three of medium sizes, and one small
,,	*Pimpinella adscendens* Dalz.	11	One largest, three large, six medium and the remaining one small
Dauceæ	*Daucus carota* Linn.	9	All same size except one which is small

The chromosome count for *Apium graveolens* Linn. agrees with that recorded by Wanscher.[1] The diploid number of *Daucus carota* Linn. is 22 according to Melderis[1] while Tamamschjan[1] and Maude[2] state it to be 18. The present count confirms the observations of the last two authors. The haploid chromosome numbers in the remaining two plants, *e.g.*, *Carum copticum* Benth. and *Pimpinella adscendens* Dalz. have been determined for the first time.

The author is thankful to Dr. R. D. Adatia for the help rendered by him during the investigations.

St. Xavier's College, Bombay-1, *January* 21, 1953. G. L. SHAH.

1. Cited from Darlington, C. D. and Janaki Ammal, E. K., *Chromosome Atlas of Cultivated Plants*, 1945, George Allen and Unwin Ltd., London. 2. Maude, P. F., *New Phytol.*, 1940, **39**, 17.

TWO-DIMENSIONAL CIRCULAR PAPER CHROMATOGRAPHY

IT is well known that in two-dimensional sheet chromatography, the mixture is spotted near one corner of the sheet. During the development with the first solvent in one direction, it is obvious that only a very narrow "ribbon" (somewhat wider than the diameter of the spot) of the entire sheet is involved. After this development, the sheet is dried, and then developed at right angles with a second solvent. Now, of course, the entire sheet of the paper is made use of.

Looking at this aspect of the two-dimensional paper chromatographic technique from the above point of view, a slight modification in it was attempted, which subsequently was applied to obtain a two-dimensional circular paper chromatogram. In doing so, the circular paper chromatographic technique of K. V. Giri and N. A. N. Rao[1] was made use of.

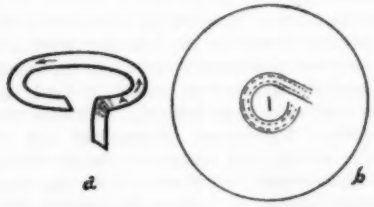

FIG. 1. *a*: The ring, tail end bent downwards. The hydrolysate was spotted at A and the arrow indicates the direction of the flow of the solvent in the ring when developed independently. *b*: This ring later stitched on to the disc. Now the flow of the liquid was from centre outwards.

PROCEDURE

A *ring* of Whatman filter-paper No. 1 was cut out, keeping a tail, which was subsequently bent downwards to dip into the solvent (Fig. 1 *a*). A fish protein HCl-hydrolysate (5 μgm. of N_2; pH, 6·5) was carefully spotted at A, fairly above this bend, and the ring was developed horizontally using butanol: acetic acid: water : : 4 : 1 : 5 as solvent.[2] This ring was 0·5 cm. in width, and its outer diameter was 6 cm. The development was effected in a small glass tank covered with a glass plate.

After the development and air-drying, the ring was stitched on to a 24 cm. disc of Whatman filter-paper No. 1 (Fig. 1 *b*), and the disc developed horizontally according to the technique of Giri and Rao (*loc. cit.*), using the same solvent, but freshly prepared, as was used to develop the ring.

The chromatogram was then air-dried, sprayed with a 0·4 per cent. ninhydrin solution made in 75% acetone, and then placed in an oven at 65° C. for 20 minutes (Fig. 2).

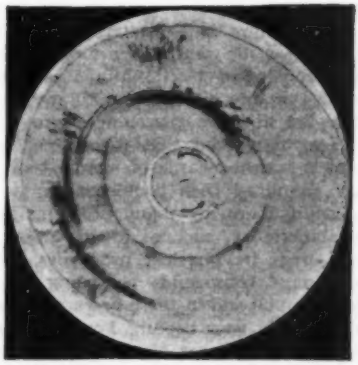

FIG. 2. The arrow indicates the direction in which the *ring* was developed *independently*.

The bands due to the amino acids (identified by the usual methods) are clearly seen, their outer tips forming a fairly smooth spiral. The faint circle in the middle is evidently due to machine-stitching of the ring, since when hand-stitched this circle does not appear. But in the latter case the development was a bit unsatisfactory.

Multiple run technique used at the two stages improves the result. Work is in progress to find out the effect of change of solvent over a wide range, and also to find out its quantitative possibilities.

The assistance given by Shri R. P. W. Master and Shri J. Barnabas is gratefully acknowledged.

Wilson College, Bombay-7, *January* 6, 1953. J. W. AIRAN.

1. Giri, K. V. and Rao, N. A. N., *Nature*, 1952, **16**, 923; *J. Ind. Inst. Sci.*, 1952, **34**, 95. 2. Partridge, S. M., *Biochem. J.*, 1947, **42**, 238.

REVIEWS

Punched Cards, Their Applications to Science and Industry. Edited by R. S. Casey and J. W. Perry. (Reinhold Publishing Corporation, New York), 1951. Pp. viii + 506. Price $ 10.00.

As Vannevar Bush stated in a recent article, "publication (of research) has been extended far beyond our present ability to make real use of the record. The summation of human experience is being expanded at a prodigious rate and the means we use for threading through the consequent maze to the momentarily important item is the same as was used in the days of square-rugged ships". Even on a small scale, individual scientific workers are often faced with the problem of tracing the needed entry in their files of information, particularly if they are interested in more than one narrow field. It has been discovered that the use of hand-manipulated punched cards of simple type considerably simplifies such problems.

Then again, there are many problems in the scientific laboratory, such as identification of a substance from its physical properties, or the classification of compounds according to their chemical formula, and in these cases also punched cards come in very useful. For the scientific computor the advantages of using a mechanical aid hardly need to be stressed. A very extensive literature has grown up on the use of punched card calculating machines for various types of computations. The book under review contains a comprehensive survey of all these applications of punched cards, and the editors must be congratulated for getting together in a single volume information on such a wide variety of topics. Part I of the book covering about 80 pages describes the elementary manipulations of hand-sorted punched cards, descriptions of some of the commercially available card systems and a general account of the fundamental procedures involved in applying punched cards to specific problems. Part II is a highly instructive account of various cases in which punched cards have been profitably applied, and forms perhaps the main part of the book. Among these may be mentioned in particular, the use of punched cards in the identification of unknown substances by optical properties, in the preparation of reports, papers and books and in routine library operations. Part III, which is more general and theoretical in nature, is concerned with fundamental problems. Its scope is best illustrated by the titles of some of the chapters—"Mathematical Analysis of Coding Systems", "Correlation of Research Data and Establishment of Cause and Effect Relationships", "Applications of Punched Card Methods to Scientific Computations". There is an excellent classified bibliography on the use of punched cards, covering 30 pages at the end of the book.

On the whole it is a well edited and well documented volume and the reviewer warmly commends it to all libraries devoted to science and technology.

G. N. RAMACHANDRAN.

X-Ray Crystallographic Technology. By A. Guinier. English Translation by T. L. Tippel. Edited by K. Lonsdale. (Published by Hilger and Watts Ltd., London), 1952. Pp. xiii + 330. Price 56 *sh.*

This is an English translation of the original book in French by Professor Guinier, which obtained an excellent reception. There is very little change in the new edition except that some of the appendices have been brought up to date, and all data regarding wavelengths and crystal dimensions are given in c.g.s. units (Ångströms).

Although a large number of books have been written about X-ray crystallography during recent years, the book under review is unique and has a special value of its own. It deals with the practical aspects of the field, although many fundamental theoretical conceptions are explained in a brief and succinct manner. Written in the style typical of French scientific books, the author spares no effort to explain things clearly even at the expense of a few extra pages. The translator must be specially complimented for fully preserving the clarity of the original version.

The first two chapters, comprising Part I of the book, deal with the general properties of X-rays and the description of the apparatus for producing X-rays. The second part contains the elements of crystallography and the theory of X-ray diffraction by crystals. The next part on experimental methods is mainly concerned with the procedures for obtaining and indexing powder and rotating crystal photographs. The

fourth and fifth parts are devoted to the applications of X-ray crystallography, such as the study of crystal texture and imperfections, the investigation of amorphous substances and the measurement of the sizes of submicroscopic particles by low angle scattering. The appendices contain a wealth of numerical data such as a table of atomic scattering factors, wavelengths of emission lines and absorption edges, absorption coefficients, tables for converting θ to lattice spacings for various wavelengths, and crystallographic data of the elements and some common compounds.

The book is addressed specially to technicians who want to use the methods of X-ray crystallography and not to crystallographers. Nevertheless, it must find a place on the table of every one interested in X-ray crystallography and its application.

G. N. RAMACHANDRAN.

Substation Practice. Second Edition. By T. H. Carr. (Chapman & Hall Ltd., London), 1952. Pp. 467. Price 55 *sh.*

The book under review is the second edition of the author's well-known book first published in 1947.

Substations play a very important function in an electrical power system—its importance has been more pronounced with the present-day development of interconnected power systems. The first edition of the book fulfilled a need for authoritative information on the subject of substations design, construction and operation. The need of a second edition in five years shows the wide interest in and the usefulness of the book.

Although no radical changes have been made either in the design and siting of substations or in their equipments since the first edition, there has been added experience in respect of applications of substation equipment. Further, as a result of the electrical supply industry in the United Kingdom having been placed under national ownership, there has been some important developments towards standardization in matters relating to the design and operation of substations.

The new edition includes additional information, illustrations and worked examples in explanation of the points discussed and brings the text up to date with the present-day practices for distribution substations. Minor errors in calculation which appeared in the first edition have now been corrected.

The book deals very effectively with the administrative and engineering problems in connection with the choice and location of sites for substations, different types of substations and their design and accessories and the commissioning and operation of the main and auxiliary electrical equipment of substations. It will be useful as reference to main and substation engineers as also to consulting engineers, operatives and students.

C. S. GHOSH.

Tables for the Analysis of Beta Spectra. (*N.B.S.* Applied Mathematics Series 13), 1952. Pp. 61. Price 35 c.

The Fermi theory of beta spectra is now well established, especially in the case of transitions that are termed as "allowed". After obtaining experimental data on beta spectra, one is faced with the task of analysing the data, according to the Fermi theory, which involves the use of the Γ function of a complex argument. The function cannot be readily evaluated and has not yet been extensively tabulated. This book of tables is intended to supply this need and it is hoped by the authors that it can be effectively utilized for most of the current and of the foreseeable needs of beta-ray analysis. The main tables which extend over 41 pages of this book, give the value of the so-called "Fermi Function", $f(Z, \eta)$, which is required for constructing the Fermi-Curie plots of the beta-ray spectra. The tabulation covers all the values of atomic number, Z, that may be encountered in practice, and extends to $\eta = 7$, where η is the electron momentum in units of mc. The set of values of η is considered sufficient for calculation of the function at intermediate values to be made by interpolation. The tables have been designed for application to the special case of "allowed" spectra.

The earlier portions of the book, extending over 21 pages, give an account of beta-ray theory and a description of how analysis of beta spectra is carried out. Graphs and figures are used to illustrate the distinction between "allowed" and "forbidden" spectra. Auxiliary conversion tables setting out values of quantities used in beta-ray analysis in terms of electron momentum and energy are given. For its size, the book is an admirably exhaustive account of beta-ray analysis and it will no doubt prove to be a valuable mathematical aid to the experimental workers in this field and also to those interested in theoretical aspects of beta-decay.

B. V. THOSAR.

The Basis of Mine Surveying. By M. H. Haddock. (Published by M/s. Chapman & Hall Ltd., London), 1952. Pp. xii + 301. Price 30 *sh.* net.

The fundamentals of mathematical problems involved in the field of Mine Surveying is well covered in this book. As the author indicates, no attempt is made to include practical surveying problems, as the main purpose of this work is to give the students in mine surveying, a thorough understanding of the fundamentals of the geometrical and trigonometrical problems involved in mine surveying. The properties of the triangle, polygon and the circle are clearly brought out and compiled in a most useful manner.

The chapter on the subdivision of areas in mining gives interesting and useful methods of aerial subdivision of various geometric figures as are likely to be investigated by the mine surveyor. The subdivision of conic areas in mine surveying has also been dealt with. The problems of resection and countersection which arise often in triangulation are treated in their various aspects. In the section on cross-cutting, methods of space analysis, or plane, or spherical trignometry are used as much as possible curtailing the applications of calculus only to the computation of extreme values.

Chapter V on Mechanical Methods of Computation give many artifices by means of which a speedy solution is arrived by methods which are especially adapted to the surveyor.

Finally, in the chapter on "Explanatory Heads" the author has emphasised the necessity for 'seeing solid' in three dimensions the various problems arising in the nature of minng survey without which capacity the work of the technician in three dimensional porperties is indeed difficult.

The book is not only useful to the mining surveyor but is of general interest to the mathematician as well.

P. MURUGA MANICKAM.

Guide to Blue Print Reading. By Ayachitam Sripada Rao, Organiser, Tech. Design Institute. (Published by the Technical Design Institute, Bangalore).

Blueprint reading presupposes the capacity to get a correct idea of the actual shape and size of the three-dimensional objects which the drawing represents. Many conventions and practices have been adopted in the making of engineering drawings so as to simplify the task of making the drawing, and also to enable proper use to be made of the drawing in the production of the article that the drawing represents.

The author in this booklet has dealt with the conventions and practices adopted in engineering drawings, and the proper interpretation of the graphical and other symbols used in the drawing as also the proper notation, numbering, and classification of drawings for easy identification and reference according to recognised methods of drafting room practice. This aspect of the subject is rarely dealt with in the manner as put forth by the author, in a concise and useful form. The book would therefore be very useful to engineers and others engaged in the manufacture and production of machine parts. Though much of the information contained in the tables and data given in the book relates to the aircraft industry, it will still be of much use to the general workshop technician.

P. MURUGA MANICKAM.

Electrochemical Data. By B. E. Conway. (Published by Elsevier; Distributors: Cleaver-Hume Press, London), 1952. Pp. xviii + 374. Price 55 *sh.*

This book is a unique compilation of physicochemical data covering a wide region in electrochemistry and allied branches of science and not generally available in handbooks.

The sets of tables given in the ten chapters of the book are each prefaced with a short introduction and are authenticated with complete references. The first chapter contains a collection of universal constants and conversion factors of importance in electrochemistry. In Chapter II are included data relating to those physical properties of solids and solutions that have a bearing on their electrochemistry. Apart from the physical properties of organic solvents, this chapter also contains ionic entropies, interatomic distances and ionic radii, electrical resistivities of metals, polarisabilities of ions and molecules, etc. The next chapter is mostly devoted to activity coefficient and osmotic coefficient data. Conductance data of organic and inorganic salts in various solvents form the subject-matter of the fourth chapter. The next chapter contains mostly the values for the thermodynamic dissociation constants of acids and bases including amino acids and peptides. Data relating to the electrical double layer at interfaces including the electro-kinetic properties of substances of biochemical interest such as mammalian hæmocytes are tabulated in the sixth chapter. The next chapter is devoted to the electrophoretic mobilities of proteins, and the importance of these values in the character-

isation of proteins is clearly indicated. In the eighth chapter there is a collection of data relating to fused electrolytes and solid electrolytic conductors. It is indeed a happy idea to present these data together in a single chapter, rather than disperse the material throughout the book.

Values relating to reversible electrode processes such as reversible potentials, redox potentials, halfwave potentials, etc., form the subject-matter of the ninth chapter. The last chapter contains a selection of the available determinations of the parameters of a number of electrode reactions such as evolution of hydrogen, deuterium, oxygen, etc., at different electrode surfaces.

It is clear that every effort has been made to make the book as up to date as possible by incorporating the results of all recent work. A volume with such an exhaustive and useful collection of data must find a place in all advanced scientific libraries, including industrial libraries. The format of the book maintains the high standard that one associates with Elsevier's publications.

A. P. M. NAIR.

Shock Syndrome—Annals of the New York Academy of Sciences, Vol. 55. Art. 3, 1952. Pp. 345-542.

The contents of this number were first presented at a symposium on the subject held by the Section of Biology of the New York Academy of Sciences towards the end of 1951. They deal with different themes associated with Shock Syndrome either with reference to its pathology or treatment. Supplementary or complementary findings are sought to be fitted in with a view to complete the "puzzle" of shock syndrome.

The conception of shock as arising from the toxic effect of "juices" from within the cell when applied without provokes thought with regard to the nature of the "juice", why and how it is released, its effects—local and general, measures possible to combat or circumvent its adverse results, etc. These ideas have led to valuable findings by the participators in the symposium. The amount of blood loss, the role of coronary circulation changes in capillary bed, kidney functions, role of 'adrenal-pituitary axis', electrolytic pattern, bacterial factor among others are some of the aspects discussed with reference to the pathology and etiology of the Shock Syndrome. The logical sequel is the treatment of the condition based on the above findings. This aspect is examined under "Physico-Chemical Aspects of Plasma Substitutes" (given the fashionable nomenclature of "Plasma Extenders") "Dextran and its Value", "Polyvinylpyrrolidone" (Kollidon or Periston or Suboosan or Macrose), "Despeciated Protein" (immune horse serum protein treated), their merits compared to whole blood and blood plasma and the practical utility of each for civilian use, or for armed forces in action.

As each subject is likely to interest workers in similar or allied fields, a comprehensive survey such as the one under review of Shock Syndrome with reference to its pathology and treatment is certain to interest medical men, and the book should most legitimately find a place in the library of any research institution and on the shelf of any clinician who desires to treat 'Shock' with real understanding.

V. ISWARIAH.

Mineral Production of the Indian Union during 1948. (*Records of the Geological Survey of India*), Vol. 82, Part 3, 1952. Pp. 329-529. Price Rs. 2-8-0.

According to the above publication, the total value of minerals produced in the Indian Union during the year 1948 was over Rs. 70 crores and the total value of metals manufactured during the year was of the order of Rs. 40 crores. The publication gives also the figures for 1939 for furnishing an idea of the progress made in the mineral industry during a span of 9 years. In 1939 the total values of the minerals and metals produced were Rs. 21·5 crores and Rs. 18·2 crores respectively. The corresponding figures for 1947, the year immediately preceding the one under review, were Rs. 64 crores and Rs. 31 crores.

The first part deals with the statistics of production and value of minerals and metal products. The notes on each mineral give data regarding its uses, treatment, average annual world porduction, Indian occurrences, reserves, quality and grade, production in the year under review and also the year preceding, figures of exports and imports, consumption in Indian industries and future prospects. The second part deals with the statistics of mineral concessions granted and terminated during the year 1948.

Proceedings of the Symposium on the Rajputana Desert. (Published by the National Institute of Sciences of India), 1952. Pp. v + 302. Price Rs. 13-2-0.

The Rajputana Desert is an important national problem which requires not only a great deal of knowledge but also careful planning for its

solution. The volume under review is therefore to be welcomed since it contains authoritative articles on various aspects of the problem from experts in the different fields. The list of papers presented at the Symposium relate to: evolution of the desert, geology and mineral resources, topographical survey of the desert region and its possible extension, meteorology and hydrology, animal and plant ecology, soils and agriculture, afforestation, reclamation and control. The recommendations adopted by the Council are given in an Appendix.

The Journal of the Madras Institute of Technology, Vol. I, No. I, 1952. Pp. 152. Price Rs. 4.

The Journal of the Madras Institute of Technology, the first issue of which was issued recently, is mainly devoted to the publication of articles on the technological aspects of science and engineering. The Editor, Dr. A. Narasinga Rao, deserves our warmest congratulations for the varied fare presented in this inaugural number. W. Repenthin has given a thirty-page review of the Aeronautical Science of To-day. Other review articles are by S. V. Ananthakrishnan on the 'Oxidation of Hydrocarbons', R. Wallauschek on the Giorgi (M.K.S.) System of Units, and V. Subramaniam on Patent Law. The journal also includes some original papers—R. Filipowsky has a paper on the Numerical Calculation of Determinants. K. K. Clark's paper presents a general form of solution for the response of a linear network to a sinusoidal or step type functions. Dr. Narasinga Rao's paper on the so-called "Kalidasa Effect" is a mathematical discussion of a statement of Kalidasa that curved lines look straight when seen from a distance. A. Suszkin has described an oscillographic method of measuring very small time intervals. There is also a historical note on the origin, growth and progress of the Institute.

Books Received

Botany of Sugarcane. By C. Van Dillewijn (The Chronica Botanica), 1952. Pp. xxii + 371. Price not given.

Encyclopedia of Chemical Technology. By Raymond E. Kirk and Donald Fothmer. (Interscience Publishing Co.) Vol. IX. Pp. xvi + 943. Subscription $ 25.00. Single Copy $ 30.00.

Maharaja Sawai Jaisingh II of Jaipur and His Observatories. By M. F. Soonwala. (Jaipur Astronomical Society.) Pp. iii + 43. Price Rs. 2.

Progress in the Chemistry of Fats and Other Lipids. By R. T. Halman. Vol. I. (Pergamon Press Ltd.). Pp. 186. Price *sh.* 42.

Prestressed Concrete. By Dr. Kurt Billig. (Macmillan & Co. Ltd.). Pp. x + 470. Price 36 *sh.* net.

Plant Life in the Scottish Highlands. By A. E. Holden. (Macmillan & Co. Ltd.) Pp. xiv + 319. Price 30 *sh.*

Inorganic Chemistry. By Joseph Reilly. (Cork University Press, Oxford.) Pp. 71. Price 8 *sh.* 6 *d.*

Symposium on Indian Oils and Fats and Their Utilization. By Dr. J. S. Agarawal. (Dabholker Press). Pp. 266. Price Re. 1.

Electrical Units with Special Reference to the M. K. S. System. By Erric Bradshaw. (Chapman & Hall). Pp. 64. Price 9 *sh.* 6 *d.*

Statistical Methods for Chemical Experimentation. By W. L. Gore. (Interscience Publishing Co.). Pp. xi + 210. Price $ 3.50.

Advances in Geophysics. By H. E. Landsberg. Vol. I. (Academic Press.) Pp. xi + 362. Price $ 7.80.

SCIENCE NOTES AND NEWS

Orobanche on Wheat (N.P. 52)

Shri S. L. Sharma, Central Sugarcane Research Station, Pusa, Bihar, writes as follows:—

This root-parasite has been known, long time back, to attack several plants belonging to Solanaceæ, a few of Cruciferæ and a plant or two of about half a dozen natural orders including Gramineæ of which *Cynodon dactylon* was recorded to have been parasitised by *Orobanche indica* Ham. (= *O. ægyptica*, Pers.) (Shaw, F. J. F., *Mem. Dep. Agri. India Bot. Ser.*, 1917, 9, 107-31). But so far there does not appear to be a record of any of its species occurring on wheat. (Kumar, L. S. S., "Flowering plants which attack economic crops—II. Orobanche", *Ind. Farm.*, 1942, 3, 638-40). *O. cernua* Lœffl. (Duthie, J. F., *Flora of Upper Gangetic Plain*, 1911, 2), was found to attack wheat plants (N.P. 52) which were growing along with *Brassica campestris* var. *Sarson* in February 1951. As crop was mixed, at first it appeared as if the root-parasite was growing

on its usual host. But there were about half a dozen isolated wheat plants which had Orobanche in close vicinity and too far away from *Sarson* plants. When their root-systems were washed, definite organic contact between the roots of wheat and Orobanche as distinct from mechanical intermingling, was found to exist.

Grateful thanks of the author are due to Shri K. L. Khanna for his keen interest in this investigation.

Breeding of Mirror Carp, *Cyprinus carpio*, in Coorg State

Shri S. H. Husainy, Department of Fisheries, Coorg, writes as follows:

In pursuance of a programme for development of fisheries in Coorg State, a consignment of 50 fingerlings of Mirror carp was imported from Ooty in 1948 and stocked in a perennial tank in Somwarpet. The first trial netting was conducted on 7-10-1952 with a small meshed cast net and 153 young ones (1½ to 3 inches in size) and a few adults (above 15 inches in size) of Mirror carp were obtained, thus indicating that this exotic fish has bred in this water and that it can be used for expansion of fish cultural operations in the State. It is also significant that this is the first instance of Mirror carp breeding at an elevation lower than 4,500′ in India. (*cf.* Alikunhi, K. N. and Ranganathan, V., *Curr. Sci.*, 1946, 15, 233; Chacko, P. I., *Progress Report on the Madras Rural Piscicultural Scheme*, 1949-50; *Ibid.*, 1950-51).

Symposium on Spectroscopy

The American Association of Spectrographers is planning a symposium on "Emission Spectroscopic Determination of Metals in Non-Metallic Samples". The symposium will be held in Chicago on May 1, 1953. Contributed papers in the fields of petroleum, geology, agriculture, pharmacy, biology, ceramics, etc., are welcome. All inquiries may be addressed to: J. P. Pagliassotti, Chairman, Symposium Committee, c/o Standard Oil Company (Indiana), Box 431, Whiting, Indiana, U.S.A.

National Register of Scientific Personnel

Part I, Volume 3 of the *National Register of Scientific and Technical Personnel in India* has just been published by the Council of Scientific and Industrial Research.

The publication lists scientists and technologists under different categories of the profession such as mathematics and statistics, physics, meteorology, chemistry, geology and mineralogy, metallurgy, anthropology, botany, zoology and entomology, agriculture and horticulture, plant breeding and genetics, plant pathology, animal husbandry and dairying, veterinary science and forestry. Experience of research, teaching, scientific and technical administration, etc., has been indicated against each person appearing in the list.

The National Register, which will be periodically revised and brought up to date, will provide a continuous census of the scientific manpower of the nation.

Handbook of Fish Culture Practices

At the invitation of the Food and Agricultural Organisation of the United Nations, Dr. S. L. Hora, Director, Zoological Survey of India, a well-known international authority on fish culture, has undertaken the preparation of a Handbook of Fish Cultural Practices in the tropical and sub-tropical countries of the world. The Handbook, which is expected to be ready by the end of next year, is intended to serve as a practical guide to fish culturists and fisheries extension workers in the underdeveloped countries of the world, where immense possibilities exist for the improvement of the diet of the people through the development of fish culture. Any person having information on fish cultural practices is requested to send it to Dr. Hora at Museum House, 1, Sudder Street, Calcutta-13, so as to make the Handbook as complete as possible.

Bangalore Machine Tool Factory

The Bangalore Machine Tool Factory which has been recently incorporated by an agreement of the Government of India with the Oerlikon Machine Tool Works, Zurich (Switzerland), is expected to go into production towards the end of the year.

The authorised capital of the Company is Rs. 12 crores and its production programme covers the manufacture of high-speed lathes, heavy duty drilling machines, shaping machines, milling machines, etc. Considerable progress has been made in the construction of the factory buildings at Jalahalli near Bangalore and also in regrd to the procurement and installation of capital equipment.

Coelacanthid Fish

On December 22, 1938, a fish of Crossopterygian type was taken by trawl-net, at a depth of about 40 fathoms some miles west of East London. The animal was unquestionably alive when caught. It was 1·5 metres in total length and weighed 127 lb. The colour was a bright metallic blue which faded to brown with preservation. This discovery naturally aroused great interest, although much disintegration of

parts had occurred. Until then, only fossil records of cœlacanthid fishes, believed to have been extinct for about 50 million years, had been available. Further details of this fish were published in *Nature* (143, 748; 1939) by Prof. Smith.

Now comes a report of further catch. This second fish was reported as having been caught on December 20, 1952, off the island of Anjouan in the Comoro group, 200 miles west of Madagascar. It was reported to be about 5 ft. long and to weigh about 100 lb. Preliminary reports suggest that the state of preservation of the fish is satisfactory. It is of interest to note that the fish was caught in 20 m. of water by an Arab, using a line, and that the islanders claim that 2 or 3 such fish are caught each year in the same region and sold in the local market. Further details are awaited with considerable interest.

Artificial Rain Precipitation

Microwave radar has proved easily the most valuable research tool for this field of study. When used from the seeding aircraft, clouds can be "probed" by radar to verify whether conditions exist for incipient precipitation. It has been shown that there are many clouds in whch all conditions necessary for the formation of rain are present, except one; so that by supplying the missing factor there is a high probability that the precipitation can be "triggered" off.

Tata Gold Medal for Zoological Research

The Sir Dorab Tata Gold Medal of the Zoological Society of India was awarded to Dr. S. L. Hora, Director, Zoological Survey of India, for the best research in Zoology during 1949-51.

Banaras Hindu University

On the recommendation of a Board of Examiners consisting of Prof. Walter Stiles, Prof. E. J. Maskell, Prof. P. Parija and Dr. K. N. Lal, the Degree of Doctor of Philosophy of the Banaras Hindu University has been conferred on Mr. Rajat De, for his thesis entitled "Studies in Nitrogen Nutrition of Sugarcane".

National Institute of Sciences of India

At the Eighteenth Anniversary General Meeting of the National Institute of Sciences of India held at the Central Drug Research Institute, Lucknow, the following were declared Officers of its Council for 1953.—*President*: Dr. K. S. Krishnan (Delhi); *Vice-Presidents*: Prof. K. N. Bahl (Patna), and Prof. S. K. Banerji (Calcutta). *Treasurer*: Prof. D. S. Kothari (Delhi); *Foreign Secretary*: Prof. P. C. Mahalanobis (Calcutta); *Secretaries*: Prof. R. C. Majumdar (Delhi), and Dr. B. P. Pal (Delhi); *Editor of Publications*: Prof. J. M. Sen (Calcutta).

The following were elected Ordinary and Honorary Fellows of the Institute:

Ordinary Fellows.—Mr. K. F. Antia, Bombay, Dr. E. C. Büchi, Calcutta; Prof. H. L. Chhibber, Banaras; Dr. M. V. Govindaswamy, Bangalore; Prof. R. P. Mitra, Delhi; Mr. K. C. Mukherjee, Calcutta; Prof. S. R. Palit, Calcutta; Mr. M. B. Raizada, Dehra Dun; Dr. Atma Ram, Calcutta; Prof. B. S. Madhava Rao, Bangalore; Prof. H. Santapu, Bombay; Prof. B. R. Seshachar, Bangalore; Prof. M. S. Thacker, Bangalore; Dr. W. M. Vaidya, New Delhi.

Honorary Fellows.—Prof. Reginald A. Daly, Geological Museum, Cambridge, Mass., U.S.A.; Prof. J. B. S. Haldane, Professor of Biometry, University College, London; Prof. Hermann Weyl, Institute for Advanced Studies, Princeton, U.S.A.

Zoological Society of India

Officers for 1953: *President*: Dr. M. A. Moghe (Poona); *Vice-Presidents*: Dr. K. N. Bahl (Patna) and Dr. M. L. Roonwal (Dehra Dun); *Treasurer*: Dr. B. S. Chauhan (Calcutta); *Editor*: Dr. N. K. Panikkar (Mandapam); *Manager of Publications*: Dr. M. L. Bhatia (Delhi); *Secretary*: Dr. P. D. Gupta (Lucknow); and *Members*: Dr. S. L. Hora (Calcutta); Dr. H. S. Pruthi (Delhi), Dr. Vishwa Nath (Hoshiarpur), Dr. H. S. Rao (Barrackpur-Calcutta), Dr. D. V. Bal (Bombay), and Shri M. N. Datta (Calcutta).

NOTICE

All material intended for publication in *Current Science*, corrected proofs, books for review and exchange journals, may please be sent to the Editor:

Professor G. N. Ramachandran,
A. C. College of Technology,
Madras-25.

Remittances, correspondence regarding subscriptions to the journal, advertisements and requests for missing numbers, etc., may please be addressed to:

The Manager,
Current Science Association,
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Yours truly
C. V. Raman
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